Engineering Library

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The Engineer.

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VOL. CXLI.—No. 3656] LONDON: FRIDAY EVENING, JANUARY 22, 1926 [PRICE { WITH INDEX AND OTHER SUPPLEMENT } 1s. 6D. BY INLAND POST 1s. 9d.

PUBLIC NOTICES

G.I.P. RLY. ELECTRIFICATION.

The Director - General, India Store Department, Branch No. 15, Belvedere-road, Lambeth, S.E.1, invites TENDERS for—

40 ELECTRIC FREIGHT LOCOMOTIVES.

Tenders due on the 9th March, 1926, before 2 p.m.

Specification and form of Tender obtainable from the above at a fee of £2 for the first three copies and £1 for each further copy. 1383

Civil Engineer Required by the GOVERNMENT of CEYLON for appointment as IRRIGATION ENGINEER for three years in the first instance, with possible permanency. Salary £500, rising to £900 a year by annual increments of £40 (£600 on attaining 30 years of age). Free passages provided. Candidates, unmarried, age 26-31, must have passed the examination to qualify for Associate Membership of the Institution of Civil Engineers or hold equivalent professional qualifications, and have had at least three years' practical experience on waterworks, drainage or harbour and dock works.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting at head of application M/14,087. 1378

Civil Engineer Required by the GOVERNMENT of NIGERIA for the Railway (Capital Works) for a tour of 12-18 months' service, with possible extension. Salary £480 a year for the first three years of service, then £510, rising to £720 by annual increments of £30 and thence rising to £920 a year by annual increments of £40. Free quarters and passages and liberal leave on full salary. Outfit allowance of £60 on first appointment. Candidates, aged 25-35, should have had experience as Civil Engineers on Railway Survey and Construction.—Apply at once by letter, stating age, qualifications and experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, London, S.W. 1, quoting M/14,361. 1380

One District Engineer (SURVEYOR) and THREE ASSISTANT ENGINEERS (SURVEYORS) REQUIRED by the GOVERNMENT of the TANGANYIKA TERRITORY for the RAILWAY DEPARTMENT for a tour of 20 to 30 months, with possible extension. Free passages and liberal leave on full salary.

M/14,228, DISTRICT ENGINEER (SURVEYOR).—Salary £790, rising to £800 a year by annual increments of £25. Candidates, not over 40 years of age, must be fully trained Railway Engineers and be qualified to make complete surveys and frame detailed estimates, to undertake reconnaissance of new railway lines and the reporting of their physical and commercial possibilities.

M/14,229. ASSISTANT ENGINEERS (SURVEYORS).—Salary £600 a year plus a consolidated field allowance of £100 a year whilst discharging duties in the Territory. Candidates, not over 40 years of age, must be fully qualified Railway Engineers with a full knowledge of barometric, tacheometric and location work, must be good draughtsmen, able to produce neat large and small maps. Must have a full knowledge of instruments and able to repair minor damages in the field, preferably should have been railway surveyors in unmapped tropical countries.

Apply at once by letter, stating clearly reference number of the appointment applied for and giving brief details of experience, to the CROWN AGENTS FOR THE COLONIES, 4, Millbank, Westminster, S.W. 1. 1379

Three Vacancies at present exist for TECHNICAL ASSISTANTS in the Torpedoes and Mining Department of the Admiralty. Candidates must have had at least five years' experience in design work in connection with low-power electrical installations as used in the Royal Navy. The posts are established and the salary attached is £400-£20-£600, with house allowance at the rate of £50 a year on salaries less than £500 and £75 a year on salaries of £500 or more. Civil Service bonus is payable in addition and at present amounts to £158 on £400 and £179 on £600. The house allowances are at present subject to an increase of 40 per cent.

Application should be made on forms to be obtained from the SECRETARY of the ADMIRALTY (C.E. Branch), Whitehall, S.W. 1.

Completed forms should be returned not later than 5th February, 1926, and candidates must be between 25 and 50 years of age on that date. Preference will be given to ex-Service candidates. 1381

The University of Birmingham.

FACULTY OF SCIENCE.

PROFESSORSHIP OF METALLURGY.

The Council of the University invites APPLICATIONS for the CHAIR of METALLURGY.

The stipend will be £1000 a year.

The Professor will be allowed to take higher consultative work, to keep in touch with metallurgical practice, provided that it does not interfere with his University duties.

Twenty-four copies of applications, together with copies of not less than three testimonials, references, or other credentials, if desired, should be received by the Secretary not later than March 1st, 1926.

The successful candidate will be required to take up his duties on October 1st, 1926.

Further particulars may be obtained from

C. G. BURTON,
1401 Secretary.

The South Indian Railway Company, LIMITED.

The Directors are prepared to receive TENDERS for the SUPPLY of—

1. FISHBOLTS and NUTS.
2. PRESSED STEEL SLEEPERS.
3. STEEL RAILS and FISHPLATES.
4. STEELWORK for BRIDGES.
5. LAMP FITTINGS and GLASSES.

Specifications and forms of Tender will be available at the Company's Offices, 91, Petty France, Westminster, S.W. 1.

Tenders, addressed to the Chairman and Directors of the South Indian Railway Company, Limited, marked "Tender for Fishbolts and Nuts," or as the case may be, must be left with the undersigned not later than Twelve Noon on Friday, the 5th February, 1926.

The Directors do not bind themselves to accept the lowest or any Tender.

A charge, which will not be returned, will be made of 2s. 6d. for each copy of Specification No. 1, of £1 for each copy of Specifications Nos. 2 and 3, of 10s. for each copy of Specification No. 4, and of 5s. for each copy of Specification No. 5.

Copies of the drawings may be obtained at the offices of the Company's Consulting Engineers, Messrs. Robert White and Partners, 3, Victoria street, Westminster, S.W. 1.

W. B. REYNOLDS,
for Managing Director.

91, Petty France, S.W. 1.
20/1/26. 1416

The Engineer

PRINCIPAL CONTENTS OF THIS ISSUE.
ARRANGED FOR CARD INDEXING.

A 4000-H.P. Two-Unit Electric Locomotive (With a Two-Page Supplement). THE ENGINEER, 22 - 1 - 26.

Electrical Method of Measuring Small Fluid Pressures. (H. A. THOMAS.) THE ENGINEER, 22 - 1 - 26.

Linoleum Machinery—No. I. THE ENGINEER, 22 - 1 - 26.

Whirling Speeds of Drum Rotors. (T. M. NAYLOR.) THE ENGINEER, 22 - 1 - 26.

Electricity Supply. THE ENGINEER, 22 - 1 - 26.

Some Improved Steam Turbines. THE ENGINEER, 22 - 1 - 26.

A Two-Stroke Crude Oil Engine. THE ENGINEER, 22 - 1 - 26.

Multiple Bar-Shearing Machine. THE ENGINEER, 22 - 1 - 26.

Automatic Train Control in America. THE ENGINEER, 22 - 1 - 26.

Index to Vol. CXL.

PUBLIC NOTICES

SHEET AND PLATE METAL WORK.

A Visiting Teacher in this subject is REQUIRED at the Verdin Technical School, Northwich, Cheshire, for Thursday afternoons, 2 to 5 p.m.

Applications to the PRINCIPAL. 1392

B.B. & C.I. Railway Company. The Directors are prepared to receive up to Noon on Friday, the 5th February, 1926, TENDERS for the SUPPLY of :—

CHEMICALLY DRESSED WAGON COVERS.

Tenders must be made on forms, copies of which, with specification, can be obtained at these offices on payment of 10s. each (which will not be returned).

The Directors do not bind themselves to accept the lowest or any Tender.

S. G. S. YOUNG,
Secretary.

Offices : The White Mansion,
91, Petty France, Westminster, S.W. 1,
21st January, 1926. 1420

Leith Dock Commission.

TENDERS FOR NEW REINFORCED CONCRETE GRAIN WAREHOUSE.

The Commissioners for the Harbour and Docks of Leith are prepared to receive from contractors who have had experience in similar work, TENDERS for the PROVISION and ERECTION of a NEW GRAIN WAREHOUSE and SILOS of REINFORCED CONCRETE, the building to occupy an area of about 170ft. by 110ft., on ground adjoining the East Quay of the Edinburgh Dock, Leith, the highest part of the building being about 150ft. above quay level.

On and after 25th January copies of the description of works, conditions of contract, specification, bill of quantities, general drawings, and forms of schedule of prices and Tender may be obtained from Alfred H. Roberts, Esq., M. Inst. C.E., Superintendent and Engineer, Dock Offices, Tower-place, Leith, Edinburgh, on payment of a deposit of Fifteen Pounds. An additional copy of the specification and schedules may be obtained upon a further deposit of Two Pounds. These deposits will be returned after the receipt of a bona fide Tender and on the return of all the documents.

The detailed drawings, showing steel work and other details, may, by appointment, be examined at the Engineer's office at the above address.

The Commissioners do not bind themselves to accept the lowest or any Tender.

Tenders, on the prescribed form, enclosed in sealed envelopes and endorsed on the outside "Tender for Grain Warehouse," must be delivered not later than 24th February, 1926, to the subscriber.

VICTOR A. NOEL PATON, W.S.,
Clerk to the Commission.

31, Melville-street, Edinburgh,
21st January, 1926. 1413

PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR THE SUPPLY OF STORES, &c.

The Metropolitan Water Board invite TENDERS for the SUPPLY of the undermentioned STORES, &c., for the period of twelve months, commencing 1st April, 1926 :—

Tender No.

1. Bricks, Fire-bricks, Cement, &c.
2. Brushes, Brooms and Handles.
3. Cast Iron Pipes and Irregular Castings.
5. Cotton Waste, Engine Wipers and Mutton Cloths.
6. Hemp, Yarn, Rope, House Flannel, &c.
7. Hire of Horses, Carts and Petrol Lorries and Supply of Sand and Ballast.
8. Iron and Steel.
9. Bolts and Nuts, Screws, Files, Tubes, Shovels and Picks.
10. Lead, Brass, Copper, Zinc and Glass.
11. Repair of Meters.
12. Fuel Oil, Oils (Lubricating), Kerosene, Motor Spirit, Greases, Tallow, &c.
13. Oilmen's Sundries, Soap, Tar, Gas Mantles, Metal Polish.
14. Packings, Rubber Goods, &c.
15. Paints, Varnishes, Linseed Oil, Turpentine, &c.
17. Pipe Laying, Repairs, Alterations, &c.
18. Scrap Iron, Purchase and Removal.
19 Small Iron, Brass, Gun-metal and other Castings.
20. G.M. Stop Cocks and Ferrules, Outlets and Caps for Hydrants.
21. Sluice Valves and Spindles, Fire Hydrants, &c.
22. Timber.
23. Maintenance of Weighing Machines.
24. Electric Lamps.
26. Furnace Refuse, Disposal.
— Photo Prints, &c.

Tenders must be made on the official forms, which may be obtained from the Chief Engineer, Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1, on and after Monday, 18th January, 1926, by personal application (Room 156) or upon forwarding a stamped addressed envelope.

Applicants should refer to the number of the Tender for which forms are required.

Tenders, enclosed in sealed envelopes, addressed to "The Clerk, Metropolitan Water Board, 173, Rosebery-avenue, Clerkenwell, E.C. 1," and endorsed in the manner indicated in the form of Tender, must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 8th February, 1926.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue, E.C. 1.
13th January, 1926. 1372

PUBLIC NOTICES

Metropolitan Water Board.

TENDERS FOR PIPE LAYING, &c.

The Metropolitan Water Board invite TENDERS for PIPE LAYING, ALTERATIONS, and BRICKLAYERS' WORK within the areas of their Kent, Northern, Southern, and Western Districts, for the period of twelve months, commencing 1st April, 1926.

Tenders must be made on the official form, which may be obtained from the Chief Engineer, Metropolitan Water Board, 173, Rosebery avenue, E.C. 1, on and after Monday, 18th January, 1926, by personal application (Room 156) or upon forwarding a stamped addressed brief envelope.

Tenders, enclosed in a sealed envelope, addressed to the Clerk, Metropolitan Water Board, 173, Rosebery avenue, Clerkenwell, E.C. 1, and endorsed "Tender for Pipe Laying, &c.," must be delivered at the offices of the Board (Room 122) not later than 11 a.m. on Monday, 8th February, 1926.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery avenue,
Clerkenwell, E.C. 1.
13th January, 1926. 1373

Metropolitan Water Board.

BARROW HILL RESERVOIR.
TENDER FOR COVERING.

The Metropolitan Water Board invite TENDERS for COVERING the ROOF (area about 7040 sup. yards) of BARROW HILL RESERVOIR, St. Edmund's-terrace, Regents Park, N.W. 8, with GRANOLITHIC COMPOUND, together with contingent works.

Drawing, conditions of contract and specification may be inspected without payment of a fee at the offices of the Board, Chief Engineer's Department (Room 201), on and after the 14th January, 1926.

Form of Tender, conditions of contract and specification, together with drawing, may be obtained on and after the 18th January, 1926, from Mr. Henry E. Stilgoe, M. Inst. C.E., the Chief Engineer, on the production of an official receipt for the sum of £5, which must be deposited with the Accountant to the Board at 173, Rosebery-avenue, E.C. 1, and which will be returned on receipt of a bona fide Tender, accompanied by all the above-named documents and drawing.

Such payments and applications must be made between the hours of 10 a.m. and 4.30 p.m. (Saturdays 10 a.m. and 12 noon). Cheques must be made payable to the "Metropolitan Water Board," and not to individuals.

Tenders, enclosed in a sealed envelope, addressed to the "Clerk of the Board," Metropolitan Water Board, 173, Rosebery-avenue, E.C. 1, and endorsed "Tender for Covering Barrow Hill Reservoir," must be delivered at the offices of the Board not later than 10 a.m. on Monday, 15th February, 1926.

The Board do not bind themselves to accept the lowest or any Tender.

G. F. STRINGER,
Clerk of the Board.

Offices of the Board,
173, Rosebery-avenue,
Clerkenwell, E.C. 1.
19th January, 1926. 1406

Watford Union.

ENGINEERING WORK.

The Guardians of the Poor of the Watford Union invite TENDERS from competent firms for the following WORKS, in sections, at their Institution, 60, Vicarage-road, Watford :—

SECTION C.—Installation of Laundry Machinery in New Laundry Building.

SECTION D.—Installation of New Water Softener and Storage Tank.

SECTION E.—Electric Lighting, consisting of Rewiring Old Buildings, New Power Mains, Motors, Main Switchboard, &c.

SECTION F.—New Central Heating Plant, consisting of Heaters, Circulating and other Pumps, Steam and Water Pipes, &c.

BUILDERS' WORK for Sections C and F. Building New Engine-house and Laundry. Constructing New Pipe Trenches and General Attendance in Cutting Away and Making Good for Engineering Contractors.

(Firms may Tender for all or any separate Section) in accordance with the general conditions, specifications and plans prepared by their Consulting Engineer, Mr. W. M. Binny, A.M.I.C.E., 30, Carlton-road, Putney, S.W. 15.

Firms wishing to Tender can see a copy of the plans and specifications at the Master's Office at the Poor Law Institution, 60, Vicarage-road, Watford, or at the Consulting Engineer's Office, Putney, by appointment before applying for a copy upon which to Tender, which copy can be obtained on a payment of £2 in notes for each Section (which will be returned on receipt of a bona fide Tender accompanied by the return of plans and specifications) at the Consulting Engineer's Office, Putney.

Firms applying for a copy of specification and plans are requested to examine the Institution first to see what work is entailed.

Tenders to be delivered in sealed envelopes only, separate from drawings (marked "Engineering Works"), at the Guardians' Offices, not later than Noon on Tuesday, 23rd February, 1926.

The Guardians do not bind themselves to accept the lowest or any Tender.

F. WILSON,
Clerk to the Guardians.

Guardians' Offices :
Watford-place, Watford,
14th January, 1926. 1396

PUBLIC NOTICES (continued) Page 2.

SITUATIONS OPEN, Page 2.
SITUATIONS WANTED, Page 2.
PATENTS, Page 2.
PARTNERSHIPS, Page 2.
AGENCIES, Page 2.
MISCELLANEOUS, Page 2.
AUCTIONS, Page 96.
FOR SALE, Pages 2, 3, 4 and 96.
BUSINESSES and PREMISES (For Sale, etc.), Page 3.
WORK WANTED, Page 4.

For Advertisement Rates see Page 101, Col. 1.

INDEX TO ADVERTISEMENTS Page 95.

PUBLIC NOTICES

Tenders are Invited from First- class firms who will undertake the MANUFACTURE of SEVERAL MACHINES of Special Type. These machines are chiefly of Cast Iron (Machined Faces and Slides) and Forged Steel Work. Approximate weight 1½ tons each. Approximate dimensions 4ft. by 2ft. by 2ft. Drawings supplied.—Further particulars address, 1419, The Engineer Office. 1419

City of Liverpool.
APPOINTMENT OF CITY ENGINEER AND SURVEYOR TO THE URBAN SANITARY AUTHORITY.

The Corporation of the City of Liverpool invite APPLICATIONS for the POSITION of CITY ENGINEER and SURVEYOR to the Urban Sanitary Authority, at a salary of £2000 per annum.

The gentleman appointed will be required to devote his whole time to the duties of the office, and will not be allowed to engage in private practice, and all emoluments out of public moneys which may be payable to or received by him will have to be paid to the Corporation.

The gentleman appointed will hold office subject to the Standing Orders of the Council, and he will be subject to the Superannuation Provisions of the Liverpool Corporation Act, 1921.

Canvassing of members of the Council will be prohibited.

Particulars of duties may be obtained on application to the Town Clerk.

Applications, stating age, experience, and qualifications, with copies of testimonials (not exceeding three), endorsed "City Engineer," addressed to the Chairman of the Health Committee, under cover to the Town Clerk, Municipal Buildings, Liverpool, must be delivered at the Town Clerk's Office, Liverpool, not later than the 30th day of January, 1926.

WALTER MOON,
Town Clerk.

Town Clerk's Office, Liverpool,
7th January, 1926. 1332

Singapore, Straits Settlements.
MUNICIPAL ENGINEER'S DEPARTMENT.
ASSISTANT BRIDGE ENGINEER.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE an ASSISTANT ENGINEER, age 23 to 26, unmarried, on a three years' agreement, with possible extension, to act as Assistant Resident Engineer on Bridge Construction.

Candidate must have a good general and technical education, and must have passed the examination for A.M. Inst. C.E. They must have received sound theoretical and practical training in general civil engineering, and have had special experience in Bridge Engineering, preferably in an office which specialises in such work. They must be competent to undertake investigation work to assist in the design of steel and reinforced concrete bridges, and to supervise the construction thereof.

Salary 5400 dollars per annum for the first year, with annual increments of 300 dollars, the value of the dollar being fixed at 2s. 4d. The pay of the appointment for the first year at the above-mentioned rate is equal to £630. Free passage will be provided with half-pay during the voyage out. A medical certificate as to fitness for ser ice in the Tropics will be required from the selected candidate.

Applications, stating age, place of birth, and giving details of education, training and experience, referring to the above requirements in detail, and stating when free, accompanied by copies (only) of testimonials and also personal references, must be lodged with Messrs. PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Commissioners (from whom further information may be obtained), not later than February 3rd, 1926. 1394

Singapore, Straits Settlements.
ELECTRICITY DEPARTMENT.
TWO CHARGE ENGINEERS.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE TWO CHARGE ENGINEERS for their new Power Station.

The capacity of the plant installed in the first instance is 12,000 kilowatts.

Candidates should have a thorough experience in extra high-tension, three-phase generation, steam turbines, water-tube boilers and mechanical stokers, and must have held a similar position previously. The possession of a Second Grade Engineer's Certificate granted by the Board of Trade is desirable.

The appointment would be on a three years' agreement, with possible extension, the salary being 5400 dollars per annum for the first year with annual increments of 300 dollars. The Straits dollar has a fixed value of 2s. 4d. The pay of the appointment for the first year at the above-mentioned rate is £630.

Free passage will be provided, with half-pay during the voyage out. A medical certificate as to fitness for servi e in the Tropics will be required from each selected candidate.

Applications, stating age, place of birth, whether single or married, and giving details of education, training and experience, accompanied by copies (only) of testimonials, and the names of three personal references, must be lodged with the undersigned (from whom further information can be obtained), not later than 3rd February, 1926.

PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Municipal Commissioners. 1403

Singapore, Straits Settlements.
ELECTRICITY DEPARTMENT.
POWER STATION SUPERINTENDENT.
ADVERTISEMENT.

The Municipal Commissioners of Singapore REQUIRE a POWER STATION SUPERINTENDENT for their new Power Station.

The capacity of the plant installed in the first instance is 12,000 kilowatts.

Candidates should be between the ages of 28 and 38. They must have a thorough experience in extra high-tension, three-phase generation, steam turbines, water-tube boilers, mechanical stokers, and must have held a similar position previously. Possession of a First Grade Engineer's Certificate granted by the Board of Trade is desirable.

The appointment would be made on a three years' agreement, with possible extension, the salary being 8160 dollars per annum for the first year, with annual increments of 480 dollars. The Straits dollar has a fixed value of 2s. 4d. Free quarters will be provided. The pay of the appointment for the first year at the above-mentioned rate is £952.

Free first-class passage will be provided with half-pay during the voyage out, and if the candidate appointed is married passages will be provided for his wife and family, if any.

A medical certificate as to fitness for ser ice in the Tropics will be required from the selected an idate.

Applications, stating age, place of birth, whether single or married, and giving details of education, training and experience, accompanied by copies (only) of testimonials and the names of three personal references, must be lodged with the undersigned, from whom further information can be obtained, not later than 3rd February, 1926.

PEIRCE and WILLIAMS, MM. Inst. C.E., 64, Victoria-street, London, S.W. 1, Agents to the Municipal Commissioners. 1404

SITUATIONS OPEN

THE POSITION of FOUNDRY MANAGER Under No. 1204 has now been FILLED. The Directors thank all applicants. 1376 A

WANTED, ENGINEER; Experience Manufacture of Heavy Machine Tools essential, some commercial training desirable; as Assistant to Manager and to travel in Great Britain.

Good opening for energetic man, Manchester district.

State experi nce, salary required, and age.

Address, 1384, The Engineer Office. 1384 A

CONSTRUCTIONAL STEEL WORK DESIGNER REQUIRED for London Consulting Engineer's Office. Must be conversant with requirements of 1909 Building Act. State experience and salary expected.—Address, P1446, The Engineer Office 1446 A

SITUATIONS OPEN (continued)

DAVID BROWN and SONS (Huddfd.), Ltd., Lockwood, Huddersfield, REQUIRE the SERVICES of a fully qualified ENGINEER having Turbine, Electrical and Rolling Mill Experience; must have commercial ability and be able to negotiate large contracts. Good prospects for right man, who would be liberally dealt with. State fully particulars of experience, qualifications, with references, age and salary required.—Address applications in confidence to MANAGING DIRECTOR. 1417 A

INDIA.—European FIRM of ENGINEERS, Iron and Steel Merchants, &c., REQUIRE a SALES ASSISTANT for their Engineering Stores, Machinery, Hardware and Metal Department. Applicants must have had a sound commercial training and be capable of dealing with inquiries and orders for the above class of material. Must be a bachelor; age 25 to 30.—Apply, giving full particulars of experience, to "Z.E. 987," c.o. Deacon's Advertising Agency, Fenchurch-avenue, London. 1409 A

PRACTICAL CONSTRUCTION ENGINEER REQUIRED for tropical service with experience, preferably on Erection of Oil Refineries. Salary 250 dols. U.S. Cy. per month. Outfit allowance granted and passage paid.—Write, stating age and full particulars, to "Z.F. 108," c.o. Deacon's Advertising Offices, Fenchurch-avenue, E.C. 3. 1423 A

REQUIRED by Old-established Firm in India, capable SALESMAN, aged about 25; must be single, with intimate knowledge of the Iron and Steel Trade.—Reply fully, stating age, experience and present salary, to "Z J. 991," c.o. Deacon's, Fenchurch-avenue, E.C. 3. 1409 A

REQUIRED for India, Well-educated and Thoroughly capable MACHINE TOOL SALESMAN, age 23-24, unmarried, with practical Machine Shop Experience and conversant with Railway Workshop Requirements.—Reply, giving full details of education, training and experience, also age and salary required, to "Z.K. 992," c.o. Deacon's, Fenchurch-avenue, E.C. 3. 1408 A

REQUIRED for Mexico, Young, Single MASTER MECHANIC. Must have all-round Machine and Repair Shop, also General Field Work experience in connection with Oil Refinery Equipment; fluent Spanish essential.—Address, 1390, The Engineer Office. 1390 A

REQUIRED for the Railway Carriage and Wagon Department of important Firm in India, competent man as MANAGER; single preferred, between 28-35 years. Modern shop and drawing-office experience and ability to control men essential. Excellent opportunity for first-class man.—Apply, with copies of testimonials and full details of training and experience, to "Z.Y. 981," c/o Deacon's Advertising Offices, Fenchurch-avenue, London, E.C. 3. 1375 A

REQUIRED for Tropical Service, MAN Experienced in Supervising House Construction, capable draughtsman and able to control labour. Salary offered 250 dollars U.S. Cy. per month, outfit allowance granted and passage paid.—Write, stating age and full particulars, to "Z.C. 965," c/o Deacon's, Fenchurch-avenue, E.C. 3. 1393 A

YOUNG MAN, with Machine Shop Experience, to Plan Operations and Fix Production Time of Accurate Instrument Components.—TAYLOR, TAYLOR and HOBSON, Ltd., Leicester. 1418 A

WANTED, a DRAUGHTSMAN Accustomed to Graving Dock Construction, Taking Levels, &c.—Address, stating experience and salary required, 1414, The Engineer Office. 1414 A

WANTED in the Midlands, ENGINEER DESIGNER, who has specialised in Conveyor and Elevator Work, particularly for dealing with packages, boxes and general merchandise. Must be expert draughtsman, competent to survey sites, prepare schemes and design complete conveying an elevating plants.—Address, stating age, qualifications, very full details of past experience, salary, and when at liberty, P1409, The Engineer Office. P1409 A

DAVID BROWN and SONS (HUDDFD.), Ltd., Lockwood, Huddersfield, REQUIRE the SERVICES of LEADING MACHINE TOOL DESIGNER. Applicants must be familiar with theory of Gearing and conversant with latest Gear-cutting Practice. State age, full particulars of experience, and wages required. 1405 A

DRAUGHTSMEN.—BEFORE NEGOTIATING with Government Departments in connection with any post, PLEASE COMMUNICATE with the GENERAL SECRETARY, Association of Engineering and Shipbuilding Draughtsmen, 96, St. George's-square, London, S.W. 1. 1169 A

DRAUGHTSMEN REQUIRED in Lay-out Drawing Office. Skilled men required, used to Lift Work.—Apply by letter only to the CHIEF DRAUGHTSMAN, The Express Lift Co., Ltd., 9, Greycoat-street Works, S.W. 1. P1427 A

GENERAL STEELWORK DRAUGHTSMEN REQUIRED for Argentine Railway. Steelwork Designers for Bridgework, with sound theoretical and practical knowledge and thoroughly competent to Design Railway Superstructures and Understructures. Men with some years' practical outside experience. State age, which should not be more than 32, and if married or single. Salary, £600 to £700 per annum, with free passage.—Reply, with details of training, experience, &c., and copies (only) of testimonials, to Box R. K., c.o. Davies and Co., 95, Bishopsgate, E.C. 2. 1415 A

REINFORCED CONCRETE.—SENIOR DESIGNERS, with specialist experience, REQUIRED by a leading firm.—Applications, giving a summary of experience, age, and salary required, to be made in the first instance to 1398, The Engineer Office. 1398 A

WANTED, FOREMAN ELECTRICIAN, Used to Electrical Control and Maintenance Work generally, in large engineering works in the Midlands.—Address, stating experience and salary required, 1421, The Engineer Office. 1421 A

EXPERIENCED MACHINE SHOP FOREMAN, to Take Charge of 200 men in Works situated 30 miles from London. Initiative and organising ability essential. Preference given to man with experience in accurate and rapid production of Steam Haulage Engines. State details of experience, age, salary required, and when at liberty.—Address, 1402, The Engineer Office. 1402 A

SITUATIONS WANTED

A CAPABLE INDUSTRIAL CHEMIST and TECHNOLOGIST DESIRES APPOINTMENT. Expert in electro-chemical processes; has held highest technical and executive appointments. Representation in a technical capacity also entertained with company affording scope and wide prospects.—Address, P1426, The Engineer Office. P1426 B

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THE PROPRIETORS of LETTERS PATENT No. 113,090, relating to "An Automatic Multiple-spindle Screw Machine," DESIRE to DISPOSE of their PATENT or to GRANT LICENCES to interested parties on rea onable terms for the purpose of EXPLOITING the same and ensuring its full commercial development and practical working in this country. Enquiries to be addressed to CRUIKSHANK and FAIRWEATHER, Chartered Patent Agents, 65-66, Chancery-lane, London, W.C. 2. 1407 H

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For continuation of For Sale Advertisements see page 3.

A Seven-Day Journal

The Coal Commission.

ON Thursday, the 14th inst., the Royal Commission on the Coal Industry brought its public sittings to an end. It has not, however, finished its labours. Some important information has yet to be received, certain statistical returns have still to be tabulated, and a number of pits remain to be inspected. Indeed, in concluding the sitting on Thursday of last week, the chairman of the Commission, Sir Herbert Samuel, stated that he and his colleagues were not yet in a position to formulate conclusions upon the more important matters to which they had been addressing themselves, and that progress so far had been confined to minor points. When the Commission began its work some four months ago, it was anticipated that it would be able to complete it by the end of February. An endeavour will still be made to finish the work by that date in order that sufficient time may be given for the consideration of any recommendations which the Commission may make. The final meeting was marked by the submission on behalf of the miners of an elaborate scheme for the reorganisation of the industry. The basis of this scheme is that coal mining should be transformed from a coal extracting to a coal-utilising industry. It should, the miners' representatives argued, become an organisation not only for the mining of coal but for the production of electrical power on a large scale, the manufacture of coke and smokeless fuel and the making of gas, fuel oils, ammonia, tar and other by-products. The transformed industry, it was added, should be nationalised, so that there might be unification of the ownership of coal, the ownership and operation of collieries, and the distribution and export of coal. The scheme as submitted contemplates the control and development of the industry by a commission, a corporation, two main councils, provincial councils in each mining district, and pit and works committees at each mine or works.

Two New Destroyers.

THE destroyer Ambuscade was launched from Messrs. Yarrow's yard at Scotstoun, Glasgow, on the 14th inst. A sister vessel, the Amazon, was to have been launched on the 16th from the Thornycroft works at Woolston, Southampton, but owing to the freezing of the grease on the ways, she could not be got into the water. These two vessels were authorised in the Navy Estimates of 1924–25, and are the first destroyers to be built for the British Navy since the war. Dimensions and other particulars have been kept secret, but it is understood that their machinery embodies the latest principles with regard to the use of high-pressure superheated steam. The Ambuscade was begun on December 8th, 1924, and the Amazon about a month later. Both are to be completed by next June. The results of their trials are likely to influence the design of the twenty-seven destroyers which are projected under the new building programme, of which the first batch of nine are to be laid down in 1927. Experience in the late war taught the necessity of increased displacement and improved sea-keeping qualities in vessels of the destroyer type. Our largest boats in service on the outbreak of war, excluding flotilla leaders, were those of the "L" class, displacing 965 tons. In the "W" class, of which our principal flotillas are now composed, the displacement reaches 1350 tons. Armaments have been increased from three 4in. guns and four 21in. torpedo tubes in the "L" boats to four 4.7in. guns and six 21in. tubes in their successors. In view of current progress abroad, where torpedo craft of unexampled size and armament are being built, it is clear that an even higher standard of tonnage and fighting power must be aimed at in our future destroyers.

The De Vecchis Beet Sugar Process.

AT a meeting of the Norfolk Branch of the National Farmers' Union at Norwich last Saturday, it was announced that arrangements were being made to build a beet sugar factory at King's Lynn to operate on the De Vecchis process. The world rights of this process, outside Italy, where it was invented, have, it is stated, been purchased by Sir Charles Cottier, who has given the British rights to the British Government. The process covers the slicing of the fresh beet into cossettes, which are subsequently desiccated in a drying apparatus. In their dried condition the cossettes may be stored for several months without loss or damage. The drying process reduces the moisture contact from 80 per cent. to about 3 per cent., and can be carried out by the grower at any time convenient for his harvesting operations. By the adoption of the process not only is the cost of carriage between the farm and the factory reduced, but the factory is enabled to work 300 days in the year instead of during a short "campaign" period of ninety days or so, as with the ordinary diffusion process at present in use. Dr. De Vecchis also claims that his process requires a reduced amount of machinery and apparatus at the factory, and therefore that it entails reduced capital expenditure on plant and equipment. A commission, it may be recalled, investigated the process on behalf of the Ministry of Agriculture about a year ago and recommended that a De Vecchis plant of small capacity, but on a factory scale, should be erected in this country to test the process experimentally. A summary of the Commission's report appeared in our issue of March 6th, 1925.

The Port of Southampton.

THE port of Southampton, which had a successful year in 1925, bids fair to surpass that record during the present year on account of the number of notable new ships which will sail from or call at Southampton. Among the new motor liners to use the port the first will be the R.M.S.P. Company's 25,000-ton ship Asturias, which will be followed later in the year by the same company's Alcantara. The Union-Castle motor liner Carnarvon Castle, which took the water at Harland and Wolff's Belfast yard last week, will also be seen at Southampton. From Holland the Rotterdam Lloyd motor liner Indrapoera calls on her maiden voyage on February 12th, and the P.C. Hooft, another large motor passenger vessel belonging to the Nederland Line, will follow at a later date. Another continental liner of importance is the Hamburg, of the Hamburg-American Line, which is now approaching completion. Among the home lines which are about to add to the business of the port is the Orient Steamship Company, which will from February onwards land Australian passengers at Southampton, whilst the Cunard Line has ordered the steamships Carmania, Caronia, Lancastria, and Cameronia south for summer service, it having been arranged that passengers s. all be embarked at Southampton. With this increase in the number of vessels using Southampton the extension of port facilities seems to be well warranted.

Ventilation of Motor Ship Engine-rooms.

THE better ventilation of the machinery spaces of motor vessels, with the object of removing any trace of oil vapour present in the atmosphere, formed the subject of a recent letter from Dr. A. G. G. Thompson, Assistant Medical Officer of Health at Liverpool, to the medical journal the *Lancet*. In his letter Dr. Thompson makes reference to the detrimental effect of such oily vapours on the health of the engine-room staff. He avers that the injurious effect is so marked that at the end of a long voyage anyone could separate with accuracy motor ship engineers from steamship engineers. His opinion is that an occupation which may cause headache, drowsiness, vomiting and loss of appetite, with often a pale yellow tinting of the skin—although different men are by no means affected alike—is likely to have a permanent effect even on the strongest constitutions. The obvious remedy, Dr. Thompson states, is better ventilation of the machinery spaces and scrupulous attention to the prevention of all contamination by oily vapour. We are glad to say that the necessity for engine-room ventilation on motor ships has been appreciated by many designers. Not only by providing more efficient fans, but also by fitting fumeless centrifugal oil separators and special crank-case fume extractors, has the problem been attacked. On the Houlder liner Upwey Grange, described in our issue of December 18th, two special extractors, designed by the Fairfield Shipbuilding and Engineering Company, Ltd., and Serck Radiators, Ltd., were fitted to the engine crank cases with excellent results as regards the atmosphere in the engine-room and a saving as regards the amount of lubricating oil used.

Sir Holberry Mensforth.

IT is announced by the War Office that Sir Holberry Mensforth, Director-General of Factories, is resigning his position at the War Office at the end of February in order that he may take up a private business appointment in the North of England. Sir Holberry has been Director-General of Factories for the past five years and will, it is understood, shortly take up the duties of managing director to Bolckow, Vaughan and Co., Ltd., iron, steel and coal masters, of Middlesbrough. He was born at Bradford, but has spent much of his business life in Manchester, where he has filled the offices of president of the Manchester Engineering Employers' Association, chairman of the Manchester District Armaments Output Committee, and general works manager of the Metropolitan-Vickers Electrical Company, Ltd. He was prominently associated with the earlier stages in the development of blast-furnace gas utilisation.

Yarrow and Co., Ltd.

FOR family reasons and in order that there may be a market value on the shares from time to time, it has been decided to turn Yarrow and Co., Ltd., into a public company. Application for leave to deal in the shares of the company is to be made to the Committee of the Stock Exchange in London and Glasgow. In accordance with the regulations of the Committee of the Stock Exchange, a statement of the firm's position was issued on Wednesday. This statement, it was intimated, was published for information only and not as an invitation to subscribe for shares. It recited the history of the undertaking from its foundation at Poplar in 1875. In 1897 Yarrow and Co., Ltd., was incorporated to take over the Poplar business. In 1906–1908 the works were transferred to Scotstoun on the Clyde. In 1922 the original company was wound up and the present one incorporated with a capital of £150,000, and the issue of debentures for £50,000. These debentures, bearing interest at 5 per cent. per annum, are held by Sir Alfred Yarrow. Of the 1922 company Sir Alfred is president, Mr. H. E. Yarrow chairman and managing director, and Messrs. W. W. Marriner and S. T. Crush directors. The balance sheet dated June 30th, 1925, issued with Wednesday's statement, shows a total liability of £347,426 13s. 9d. The assets offsetting that amount include £118,742 2s. 5d. for work in progress, stores, &c.; £34,000 for buildings; £57,000 for plant and machinery; £78,798 13s. 9d. for investments; £58,885 17s. 7d. for sundry debtors; and nothing for goodwill. The figures entered against buildings, plant and machinery are very low compared with the actual values.

Imperial Trade.

SIR FREDERICK MILLS, president of the Iron and Steel Institute, differs from some other leaders of the iron and steel industry, in so far that he is convinced that sooner or later this country will be compelled to safeguard or protect that industry. Speaking at Glasgow a week ago, he remarked that the country's affairs were at present in a curious state, for while all sorts of luxury trades were flourishing, the basic iron and steel, coal, shipping and cotton industries were very depressed. In the coal, steel and iron trades, he declared, no one wanted to see the men working for reduced wages. What was wanted, he said, was longer hours and good, honest work by the men employed. America, France, Germany and Sweden were all flourishing under their tariff systems. How long, he asked, were we in this country going to carry on the great iron trade without a tariff? The British Empire was large enough to trade with, and in his view means would soon be found to enable us to trade first with our own people. Other countries would then seek to make terms with us. In this connection the remarks on Australian trade made on Monday by Sir Joseph Cook as president of the Australasian Chamber of Commerce in London are worthy of note. Sir Joseph contended that while the object of the Australian tariff was to shelter the country's young industries, British manufacturers should understand that they would be welcomed within those sheltering walls. He urged them to consider the setting up of factories in Australia, where they would find a protected market waiting for them. Incidentally, Sir Joseph remarked that the past year had been a record one for Australian trade, the total volume of overseas trading being £319,222,988, a figure exceeding the highest previously recorded by over £23,000,000. The adverse trade balance of £21,000,000 in 1924 had in 1925 been converted into a favourable surplus of nearly £5,000,000. Of the total imports in 1925, 43.9 per cent. were of British origin, a figure slightly lower than that recorded in 1924. American goods were imported to about the same extent as in the previous year.

Bulk Electricity Supply.

THE action of the Government towards the production and supply of electricity from large generating stations was criticised at a recent meeting of the Barnes (North Surrey) District Council. It was contended by Councillor S. E. Jackson that if the Council had taken a supply from the Barking super power station instead of generating it for itself, there would have been a loss of £10,000 per annum by the transaction. Councillor Jackson also explained that the County of London Electric Supply Company, Ltd., the owner of the Barking Station, was charging 7.15d. per unit for lighting on one side of the Richmond-road, whilst on the other side the Council was charging 4½d. per unit.

The Post Office Tube Railway.

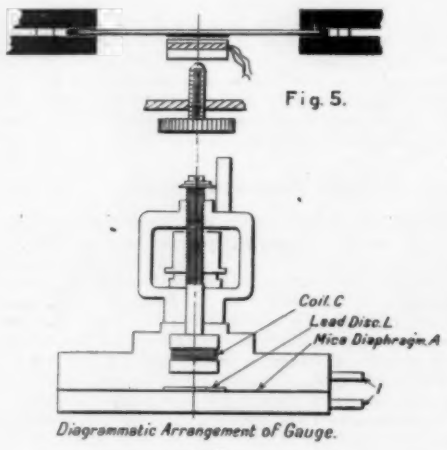
THE Post Office Tube Railway, extending from Paddington Station in the West to Whitechapel in the East of London, a total distance of about 6½ miles, is, we learn, rapidly being pushed towards completion, and will, it is anticipated, be in full working order by July. The tube, 9ft. in diameter, accommodates two sets of rails on which automatically controlled electric wagons, each carrying 10 cwt. of mails, will run at a maximum density of thirty trains per hour in each direction. A number of sub-stations have been constructed along the route, giving access to several important dispatching and collecting centres and plans are under consideration for extending branches northwards and southwards. The running and live rails have been laid in the tube, and the electrical plant is being installed as quickly as possible by the contractors, the English Electric Company. Ninety wagons in all are being built for the conveyance of the mails. Some details of the constructional work and particulars of the first experimental wagon, as tested on a trial track laid down at Woolwich, were given in an article which we published in our issue of October 10th, 1924.

An Electrical Method for Measuring Small Fluid Pressures.

By H. A. THOMAS, M.Sc.

DURING a recent investigation on air flow, the need arose for a portable form of pressure gauge arranged with an indicating device which could readily be adjusted whilst the gauge was in use, for the purpose of varying the "magnification ratio."

A form of gauge commonly employed in aeronautical practice was chosen. It consisted of two air-tight chambers separated by a thin diaphragm and having a mechanism arranged to transmit the motion of the diaphragm to a pointer capable of moving over an angular scale. This mechanism was completely enclosed within the gauge and could not readily be modified to meet the special requirements. It was therefore replaced by an electrical device, first employed by the author as an accurate method of indicating small movements. As an example of a special application of this method a description of the gauge may not be without interest.



Diagrammatic Arrangement of Gauge.

Fig. 5.

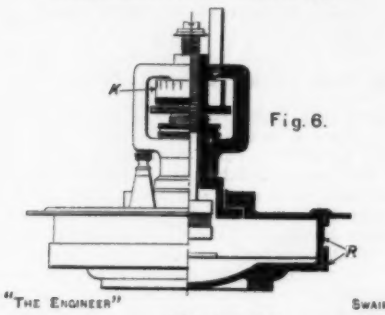


Fig. 6.

FIGS. 5 AND 6

This gauge was developed in consultation with Mr. L. F. G. Simmonds, M.A., of the Aerodynamics Department of the National Physical Laboratory, to whom the author's thanks are due.

The general principle on which the apparatus is based has already been published;* for the sake of completeness it is convenient to refer to it here in some detail.

In a Hartley high-frequency oscillating circuit as shown in Fig. 1, the anode current is given approximately by the mean of the values of anode current obtained at the peak values of the applied grid volts. Thus in Fig. 2, showing the $v_g - i_a$ characteristic, with zero grid volts, the anode current will be I. If an alternating voltage be applied to the grid, and if the maximum change of grid potential on either side of the zero is V, the anode current will change from I_1 to I_2 and its mean value will be I_3, which is different from the original I, if the characteristic is unsymmetrical about the vertical axis through the point P. Under certain conditions, with a suitable characteristic, it is possible to obtain a very large anode current change for any applied alternating grid potential.

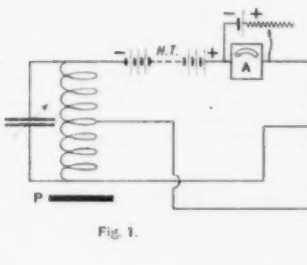


Fig. 1.

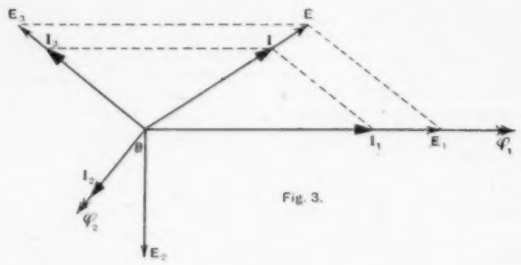


Fig. 3.

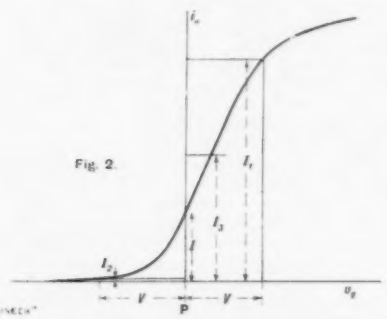


Fig. 2.

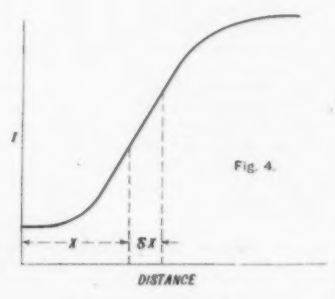


Fig. 4.

FIGS. 1 TO 4—HARTLEY OSCILLATING CIRCUIT AND CHARACTERISTICS

Now let us consider the case of an oscillating circuit in the proximity of which a metallic body can be introduced as shown in Fig. 1.

The normal voltage and current in the oscillating circuit is given by E_1 and I_1, Fig. 3. When the metal body is brought into the high-frequency field the flux φ in phase with I_1 will produce an electromotive force E_2, lagging by 90 deg. This electromotive force gives rise to an induced current I_2 in the metal, lagging by an angle θ, the value of which will depend upon the inductive and resistance components of the path taken by the current in the plate of the metal.

This current I_2 will produce a counter-changing flux φ_2, and thus an electromotive force E_3 in the oscillating circuit again lagging by 90 deg. The frequency will remain unchanged, and therefore a current I_3 in phase with E_3 will be produced. Finally the net electromotive force and current will be E and I both in phase, but smaller in magnitude than the original vectors E_1 and I_1.

The effect of the proximity of the plate is thus virtually to increase the effective resistance of the oscillatory circuit, the electromotive force causing, in general, a reduction in the value of the current, but without altering the phase relationship between the two.

It should be noted here that the angle of lag depends on the electrical resistivity of the material, and it will therefore be clear that, since the current path is affected seriously by the material used, a metal having a high electrical resistivity will produce a current nearly in phase with the vector E_2, thus giving the smallest final value of I. If, on the other hand, the current path is of low resistance, the current I_2 will lag nearly 90 deg. behind the electromotive force E_2, giving a smaller final change in I. The above remarks apply when the plate is at a definite distance from the oscillatory circuit; it will be readily appreciated that the absolute magnitude of the vectors E and I is also a function of the induction, and therefore depends upon the distance of the plate from the circuit.

The curve connecting anode current with the distance of the metallic plate from the coil is shown in Fig. 4. It will be evident from the figure that when the plate is adjusted to be at the mean distance x from any arbitrary plane in the coil, small movements of the plate relative to the coil produce large linear changes in the anode current. In this particular application of the method the coil is fixed near a thin sheet of lead attached to the centre of the diaphragm and any movement of this diaphragm from its mean position is then indicated by a large change in the anode current.

The actual arrangement of the apparatus is illustrated diagrammatically in Fig. 5.

The coil is adjusted by means of a micrometer screw to be near the sensitive point—*i.e.*, such that it lies on the steepest part of the characteristic curve—whence any displacement of the diaphragm will produce the largest change of the anode current.

DETAILS OF APPARATUS.

Fig. 6 gives a detailed drawing of the pressure chamber and diaphragm. The diaphragm consists of a disc of mica A, 0.004in. thick and 3.5in. in diameter, which is clamped between two rings R. A thin disc of lead L 1¼in. in diameter is attached concentrically, as shown, and it acts as the moving plate.

The oscillating coil C is fixed to a non-rotating micrometer screw actuated outside the chamber by the knurled head K. This is for calibration purposes, and is used for determining the relationship between deflection of the diaphragm, representing the differences of pressure and the changes occurring in the anode current. Inlets to the separate chambers are shown at I on the two sides.

The control panel is shown in Fig. 7. It consists of a valve, with its attendant tuning condenser connected across the oscillating coil. A galvanometer shunt and balancing resistance are also incorporated in this panel. The recording instrument may be either a sensitive pointer micro-ammeter or, for more accurate work, a reflecting galvanometer.

CALIBRATION.

The current displacement curves obtained are shown in Fig. 8 for various frequencies, with a constant filament current and high-tension voltage, using a Marconi-Osram T.15 valve. It will be observed from these curves that the slope over the linear portion, which is a measure of the sensitivity, is independent of the oscillating frequency, changes

FIG. 7—ELECTRIC CONTROL PANEL

in which merely move bodily the arbitrary datum line, from which the motion is observed.

A similar set of curves is given in Fig. 9 for a smaller value of the filament current, and it is seen that the sensitivity is inappreciably affected, thus demonstrating that the ordinary filament current changes, likely to occur in practice, would not lead to serious errors when the instrument is used as a sensitive detector of differences. The third set of curves, Fig. 10, gives the characteristics for various anode voltages, and shows that as the anode current saturation value is lowered the sensitivity is necessarily reduced. In Fig. 11 the actual static characteristic of the triode is given.

The zero obtained by the balancing arrangement was found to remain sensibly constant, the creep due to slight battery changes being as a maximum about one-half of a micro-ampère per minute. This can be reduced by carefully selecting the batteries employed.

Finally, the instrument was calibrated to determine the deflection of the diaphragm per unit difference of

* "Precision Measuring Instrument for Small Motions of Solid Bodies," THE ENGINEER, February 9th, 1923.

pressure on the two sides, this being a constant of the instrument and independent of the electrical mechanism.

If $p = K x$, where p = pressure in inches of water, and x = displacement of centre of diaphragm in inches, it was found as a result of several tests that $K = 52 \cdot 6$.

The sensitivity of the electrical mechanism at 102 volts high tension and 0·935 ampères filament current and 71·5 kilo-cycles per second was found to be from curve 9, 1·84 milliamps. change per $^1/_{100}$in. The sensitivity of the galvanometer was about 1 m. deflection per micro-amp. at a distance of 1 m. from the mirror.

Therefore 1 cm. deflection on the galvanometer means a change of 10^{-8} ampères, which is equivalent to $10^{-2} \times \frac{10^{-3}}{1 \cdot 84 \times 10^{-3}} = 0 \cdot 544 \times 10^{-7}$in. displacement of the centre of the diaphragm, which again is equivalent to a pressure change of $52 \cdot 6 \times 0 \cdot 544 \times 10^{-7}$in. of water $= 2 \cdot 86 \times 10^{-6}$.

Whirling Speeds of Drum Rotors.

By T. M. NAYLOR, M.Sc., A.M. Inst. C.E., A.M.I.M.E.

A GRAPHICAL method is usually employed to obtain the whirling speeds of drum rotors. Briefly, the method is to obtain the static deflection curve for the rotor under consideration, and then the whirling speed is calculated from $\frac{30}{\pi}\sqrt{\frac{\Sigma w y}{\Sigma w y^2} \cdot g}$.

The expression $\frac{30}{\pi}\sqrt{\frac{\Sigma w y}{\Sigma w y^2} \cdot g}$ is obtained by equating the total resilience to the total kinetic energy of the shaft. The rotor is divided into a number of sections; the weight of each section is determined, and the deflection of its centre of gravity is obtained from the deflection diagram. Then, $\Sigma w y$ and $\Sigma w y^2$ are calculated, the calculation being best done by tabulation. Full details of this method are to be found in "Strength of Materials," by Dr. A. Morley, "Steam Turbines," by Professor W. J. Gouldie, and in many other text-books.

A modification of this method is used by some engineers. The static-deflection curve is found, and from this curve the maximum deflection is measured. The whirling speed is then calculated from $\frac{K \times 187 \cdot 8}{\sqrt{\delta}}$, where δ is the maximum deflection in inches and K is a constant, the value of which depends upon the distribution of the loads on the shaft. For turbine rotors K is usually taken at 1·065, so that the whirling speed in revolutions per minute is given by $\frac{200}{\sqrt{\delta}}$. This method is time-saving, but is not quite so accurate as the first-named method.

Sometimes another method is used to obtain the whirling speed of a drum rotor. It is assumed that the rotor can be replaced by a single disc of a weight equal to the weight of the rotor and also that this disc acts at one point on the shaft. For example, in the case of the drum rotor—represented in Fig. 1—the weight of the rotor would be found and would be supposed to act at one point—as shown by Fig. 2. The lengths of the shafts used in this method are indicated in the diagrams, the lengths L_1 and L_2 being the same in both cases.

The problem is now resolved into the case of a shaft carrying a single mass. The whirling speed of a shaft loaded in this manner is easily obtained by using Professor S. Dunkerley's well-known methods The whirling speed of the shaft alone is first obtained. It may be found from the expression:

$$N_1 = 4{,}800{,}000 \frac{d^2}{L}$$

where N_1 is the whirling speed of the shaft in revolutions per minute;
d is the diameter of the shaft in inches; and
L is the length of the shaft in inches.

Then the whirling speed of the mass mounted on a shaft, supposed to be massless, is found. For this determination, the following expression may be used—

$$N_2 = 187 \cdot 8 \times 1 \cdot 732 \sqrt{\frac{L.E.I.}{d^2 c^2 W}}$$

where N_2 = the whirling speed of the mass in revolutions per minute;
L = the length of the shaft in inches;
E = modulus of elasticity in pounds per square inch;
I = moment of inertia about a diameter;
d = distance of the mass from, say, the left-hand support, in inches;
c = distance of the mass from, say, the right-hand support, in inches;
W is the mass in pounds.

Using Professor Dunkerley's well-known expression, the whirling speed of the loaded shaft is then found from the equation—

$$\frac{1}{N^2} = \frac{1}{N_1^2} + \frac{1}{N_2^2}$$

where N_1 = whirling speed of shaft alone;
N_2 = whirling speed of mass alone;
N = whirling speed of the loaded shaft.

In order to obtain a comparison between the graphical and the calculation method, a simple drum rotor was made. The rotor was made so that it could easily be "massed up." As shown in Fig. 3, it consists of a cylinder with two equal discs, one being placed at each end of the cylinder. To the discs are fitted lengths of shaft L_1 and L_2. To "mass up" the rotor, the two discs are placed at the centre of the cylinder, and a new length of shaft is fitted, which passes through the two discs—see Fig. 4. The total length of this shaft was made equal to $L_1 + L_2$. The joints between the cylinder and the discs, and between the discs and the shaft were driving fits.

The whirling speed of each rotor was found by—(1) Experiment; (2) the first graphical method mentioned; (3) calculations from Professor Dunkerley's expressions. In each case the rotors were driven by means of a 5 horse-power de Laval turbine. A spiral spring was inserted between the turbine shaft and the experimental shafts in order to prevent any torsional oscillations being transmitted from the turbine to the experimental shafts. The rotors were carefully balanced and the whirling speeds were taken by means of an Elliott speed counter. The rotors were mounted in short bearings, so that they could be taken as being simply supported.

The results obtained were as follows:—

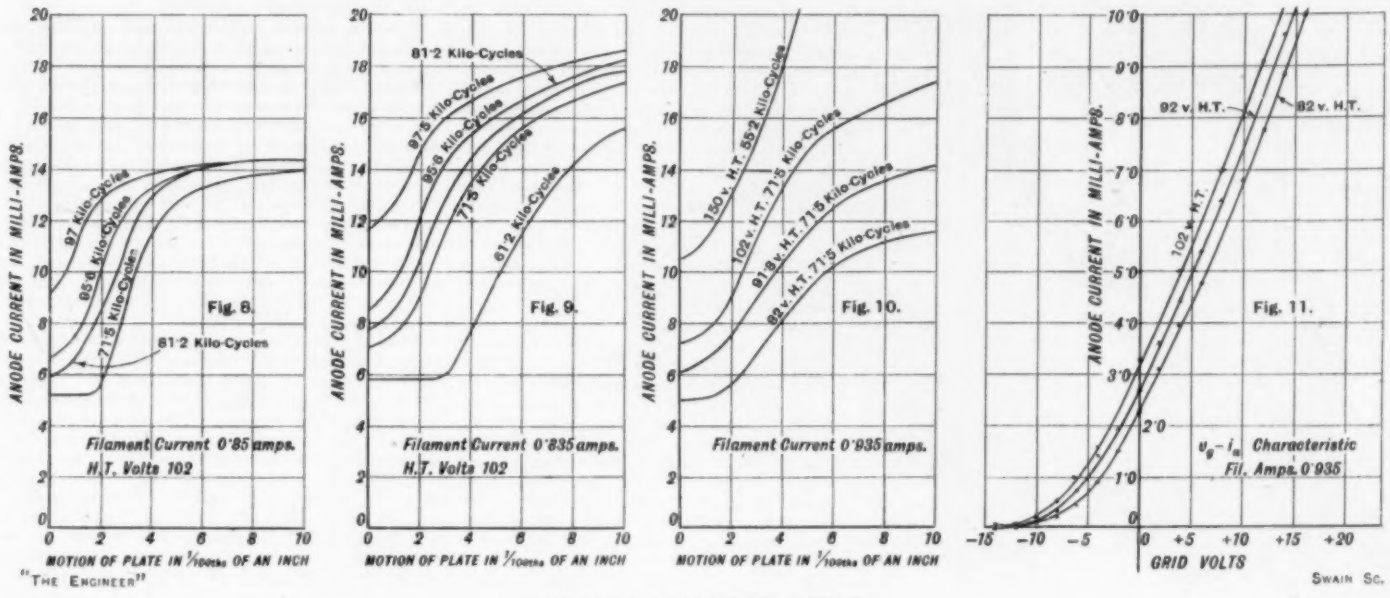
Drum Rotor.

Whirling speed by experiment	550 r.p.m.
Whirling speed by graphical method	555 r.p.m.

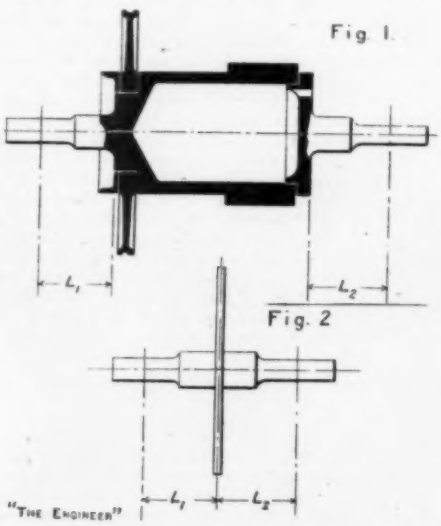
"Massed-up" Rotor.

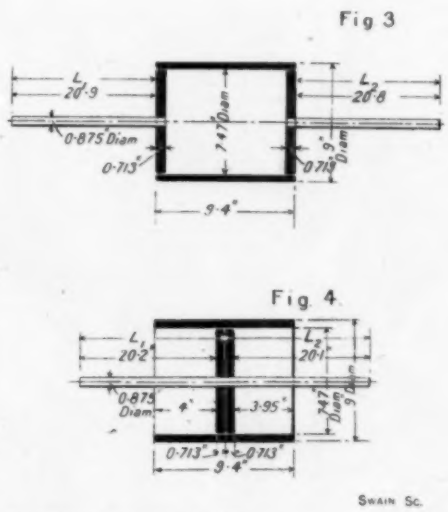
Whirling speed by experiment	540 r.p.m.
Whirling speed by calculations from Professor Dunkerley's expressions	520 r.p.m.

From these simple experiments and calculations, it can be concluded that if drum rotors are "massed-up" and Professor Dunkerley's expressions used, very close approximations to the whirling speeds will be obtained. It must be remembered that if this method is employed the rotors must be considerably stiffer than the shafts. Moreover, it will be noticed that if the whirling speeds are to be high, then the lengths of shafts denoted by L_1 and L_2 must be kept small.



FIGS. 8 TO 11—CHARACTERISTIC CURVES





FIGS. 1 TO 4—DRUM ROTOR AND EXPERIMENTAL APPARATUS

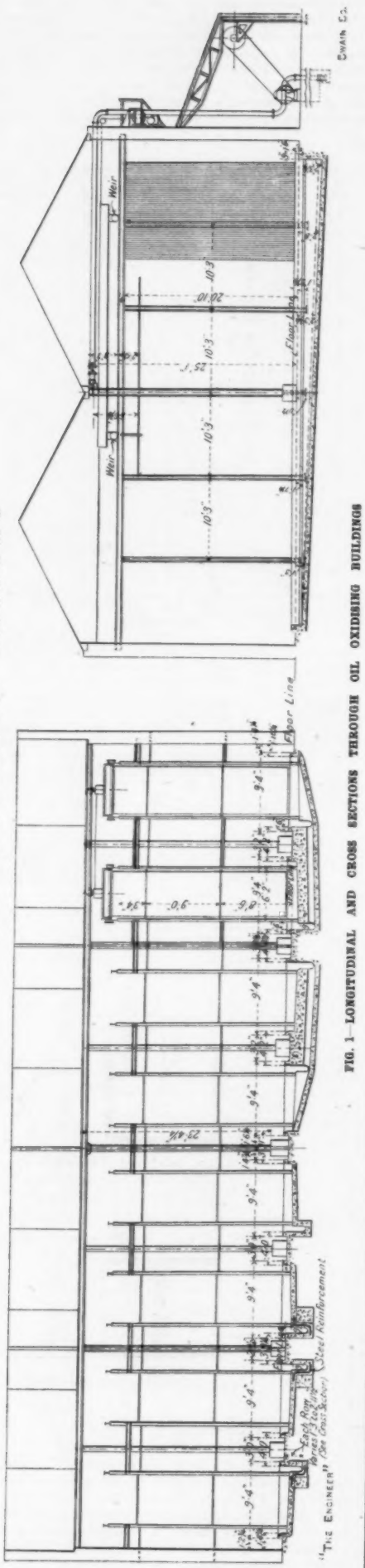


FIG. 1—LONGITUDINAL AND CROSS SECTIONS THROUGH OIL OXIDISING BUILDINGS

Linoleum Machinery.

No. I.

THE manufacture of linoleum in this country is, to all intents and purposes, a closed industry controlled by a very few firms—there is scarcely a score of linoleum factories in the United Kingdom—and concerning which very little information is known outside the trade. At the present time there is, however, a tendency towards the erection of new factories in our overseas dependencies, and in view of the fact that the processes of manufacture involve the use of a large amount of machinery of peculiar technical interest, it seems appropriate that some account should be given of the plant employed.

In this article, and others which are to follow, we have gathered together such information on the subject as is available, but it should be pointed out, at the outset, that the machines described are essentially typical. It is a peculiarity of linoleum manufacturers that each one has individual methods that differentiate the processes employed in minor details, and for that reason machines are frequently modified by the purchasers after they have been delivered by the engineers, while most of the factories have extensive workshops of their own where complete machines can be turned out. The proprietors, only naturally, do not like to have detailed particulars of these modifications made public, but all the machines which we illustrate are complete in themselves and have been put to work as shown.

Before going on to describe the machinery, it will be best to give an outline of the general process of making linoleum, and the following notes are based on visits to several of the more important linoleum factories in the country, notably the pioneer works of the Linoleum Manufacturing Company at Staines; the New Shepley Linoleum Company, Manchester; and some of the North Country works, including those of Barry, Ostlere and Shepherd at Kirkcaldy. They are not intended to give a connected account of the whole process as it is carried out in any one of those factories, but rather to describe the alternative systems in the proper sequence.

Linoleum, by the way, is a term very loosely applied by the public to all kinds of floor covering made of cork and oil, but in the trade a sharp distinction is drawn between linoleum and corticene on account of the differences in the process of preparing the oil; the former being the outcome of the ingenuity of Mr. Fred. Walton, who was interested in the manufacture of kamptulicon—the floor covering of cork and india-rubber which preceded linoleum.

The rapidly increasing cost of rubber in the first half of last century led Mr. Walton to cast about for a substitute, and he was attracted by the skin on the surface of a pot of paint which had been exposed to the air. He found that this skin possessed many of the qualities necessary to enable it to take the place of rubber, and set to work to devise means for producing such a skin in quantities appropriate to the manufacture of floor coverings. His experiments were eminently successful, and in 1863 linseed oil almost completely took the place of rubber and gave its name to linoleum.

Corticene was the later invention of Mr. Charles Taylor, who aimed at expediting the process of manufacture. Both linoleum and corticene are, however, similar in so far that they are composed of granulated cork bound together with a cement prepared from linseed oil, together with several other ingredients. Linoleum unquestionably has the finer surface of the two materials, but it is held by some that corticene possesses better wearing qualities, and it certainly has the greater resilience. It is noteworthy that some linoleum manufacturers are introducing fish oil, to some extent, as a substitute for linseed oil.

Up to the point where the cement is ready for mixture with the cork the two processes are distinct, but from there onwards they follow very nearly parallel lines. We will first describe the alternative methods of preparing the cement and then go on to the machinery used in its incorporation with the cork and conversion into the finished floor covering.

THE CEMENT.

The cement is a compound of oxidised linseed oil, kauri gum and rosin, and it is in the oxidation of the oil that the two principal processes differ. In arranging for the preliminary oxidation of the oil, Mr. Walton was, no doubt, largely influenced by his original observation and endeavoured to simulate the surface skin on the paint pot on a large scale. To this end he provided a very large area of oil surface for subjection to atmospheric oxidation, and the process is still carried out at Staines on exactly the same lines.

The first operation in the preparation of the oil is to heat it up to a temperature of, say, 415 deg. Fah. in conjunction with driers, such as sugar of lead or manganese. After cooling down again the oil is then sent on to the department, where it is oxidised atmospherically.

In a substantial building—such as that illustrated by Fig. 1—there are hung up a large number of strips of scrim cloth, very similar to the fabric used for covering cheeses. Each strip is about 3ft. wide by 21ft. long, and is glued on to a batten at the top and the bottom. The top batten provides a means of hanging the strip in a gantry, while the lower one is held by vertical slides to accommodate variations in length. The cloths are hung at intervals of a few inches apart, and are generally so arranged in the building that there is a gangway between adjacent pairs, while there is sometimes another gangway half-way up their height, so that the attendant can conveniently separate any cloths which may accidentally come into contact with one another.

These cloths provide a very large area over which the boiled linseed oil is flooded for exposure to the air, and consequent oxidation. The flooding is effected by means of overhead troughs, which are travelled backwards and forwards on wheels running on the gentry. The troughs are as wide as two scrim cloths, and have weirs over which the oil flows in a thin film on to the cloths below.

It will be readily understood that oxidation of the oil on any part of the plant, except on the scrim cloths, must be avoided as far as possible, as such oil will be difficult to harvest, and for that reason the stanchions of the gantry are draped round with cloth, so that the oil film which would otherwise form on the metal surface, on account of splashing, may be easily recovered. For the same reason the means of supplying the overhead distributing troughs with oil are simplified as far as possible. In this connection it should be pointed out that the flooding of the cloths is effected only once in every twelve hours, and during the whole of the remainder of the time all the surfaces which have been wetted with the oil will accumulate a skin that may be recoverable or not according to the circumstances of its deposition.

The oil is pumped up into pipes in the upper part of the building, and is distributed by means of swan-neck pipes, so arranged that there is a seal which prevents air from finding its way back into the piping when pumping is stopped. The oil flows into troughs mounted on trolleys running over the tops of the gantries. These troughs, as indicated, are, more or less, of cruciform plan, so that the transverse troughs may be continuously supplied with oil while they are travelled along the building beneath the fixed supply pipe. The oil flows over a weir on the transverse part of the trough and then down the scrim cloths below. Any oil which drips off at the bottom is collected in a sloping channel and is returned to the pumping system. The adjacent troughs are so connected that they move in opposite directions along the gantries, and the operating mechanism—a drawing of which is given in Fig. 2—is generally arranged outside the building, as the atmosphere in the sheds is very oppressive on account of the fumes given off by the oil in drying.

We have asked several manufacturers if climatic conditions have any influence on the production of the oxidised film of oil, as it is a well-known fact that the drying of ordinary paint is so influenced, but it appears that such considerations are not of great importance to the linoleum manufacturers, and the geographical distribution of the factories employing this process of oxidation supports this idea.

The flooding of the scrim cloths is, as already mentioned, carried out about every twelve hours, and is continued over a period of from six to nine months. During this time the depth of the film of oxidised oil carried by the cloth is gradually increased until it is anything up to $\frac{3}{4}$in. thick. The process might, of course, be continued indefinitely, but in the course of time the scrim cloth "perishes," and the weight of the oil skin becomes more than it can support. When that stage is reached, it is a not uncommon practice to shear off the lower part of the skin for immediate use, and thus relieve the upper part of some of the weight. It is important that the skins should not be allowed to collapse on the floor, as, if they were left unattended in a heap there would be a tendency towards spontaneous combustion, and it is obvious that a fire once started in such a building would be unmanageable.

In some works it is found that the increase of temperature produced by the natural oxidation of the oil is sufficient, in itself, to provide all the ventilation necessary in the oxidising sheds; but generally the process goes on better if a constant temperature of from 110 deg. to 120 deg. Fah. is maintained, either by steam pipes or air heating.

The "skins" of oxidised oil carried by the cloths are of about the same consistency as ordinary "Scotch" glue which has been soaked in water for a short time. They are springy and have lost all "tackiness." Incidentally, the cloth has become so tender during its long encasement by the oil that it has lost practically all its original nature, and there is no necessity to attempt to separate the oil skins from the foundation cloth. These skins are taken down from the gantry and are ready for the next process of manufacture. It is noteworthy that the weight of the skins is greater than that of the oil used in their formation—to the extent of the oxygen which they have taken up from the atmosphere; whereas with all the other processes of preparing the oil there is a slight loss during oxidation.

On account of the long period of time occupied in the skin-oxidising process, during which time the capital cost of the oil is, of course, bringing in no return, Walton devised a more rapid system, in which the oil was allowed to fall like rain in a heated building, and was subsequently agitated in heated con-

tainers with air. This process is not very largely employed nowadays, but it was the basis of a more elaborate scheme, one of the best examples of which is that at the Kirkcaldy works of Barry, Ostlere and Shepherd. In these works the raining system is also employed, but instead of being carried out in large

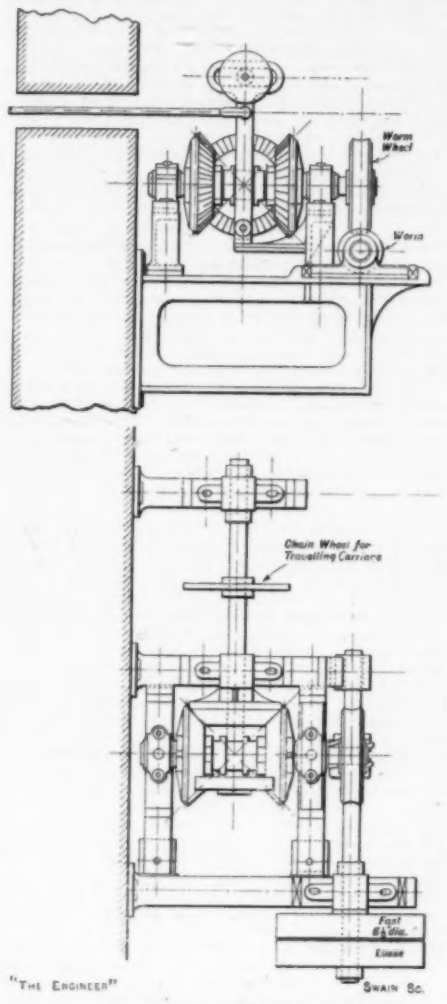


FIG. 2—OIL TROUGH OPERATING MECHANISM

rooms it is effected in tall steel cylinders, and the arrangement has the consequent advantage that separate consignments of oil can be treated individually. The cylinders are about 25ft. high by 6ft. in diameter, and have a conical bottom, which is connected with the suction of a centrifugal pump—

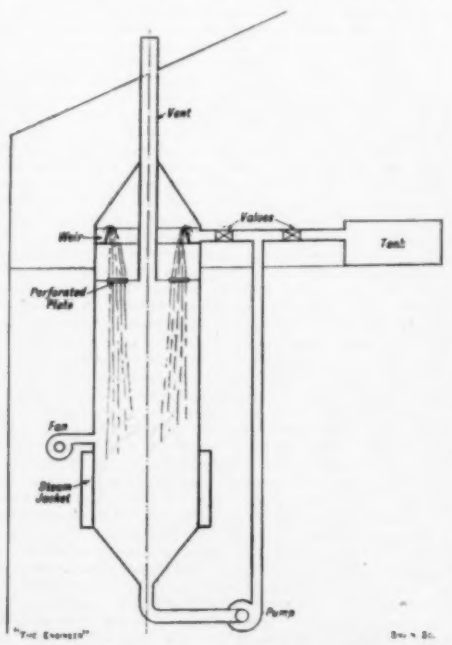


FIG. 3—WALTON OIL-OXIDISING APPARATUS

see Fig. 3. Incidentally, it is noteworthy that the packing glands of these pumps need more than the usual amount of attention, as the oil appears to have a scoring effect on the spindles as it becomes oxidised. The bottom of the cylinder is also provided with a steam jacket, and is maintained at a temperature of about 130 deg. Fah.

The apparatus contains approximately 4 tons of oil at a time, and this oil, mixed with dryers, is continuously pumped up to the top, where it flows over an annular weir which distributes it over a series of perforated plates, as indicated in Fig. 3, so that it falls as a rain inside the cylinder. The perforation of the plates is one of the delicate affairs in the design of these plants, since, as is obvious, it is desirable to make the rain as fine as possible, to expedite the process; but it is necessary, on the other hand, to make the holes large enough to pass the oil when it becomes thickened by oxidation. So

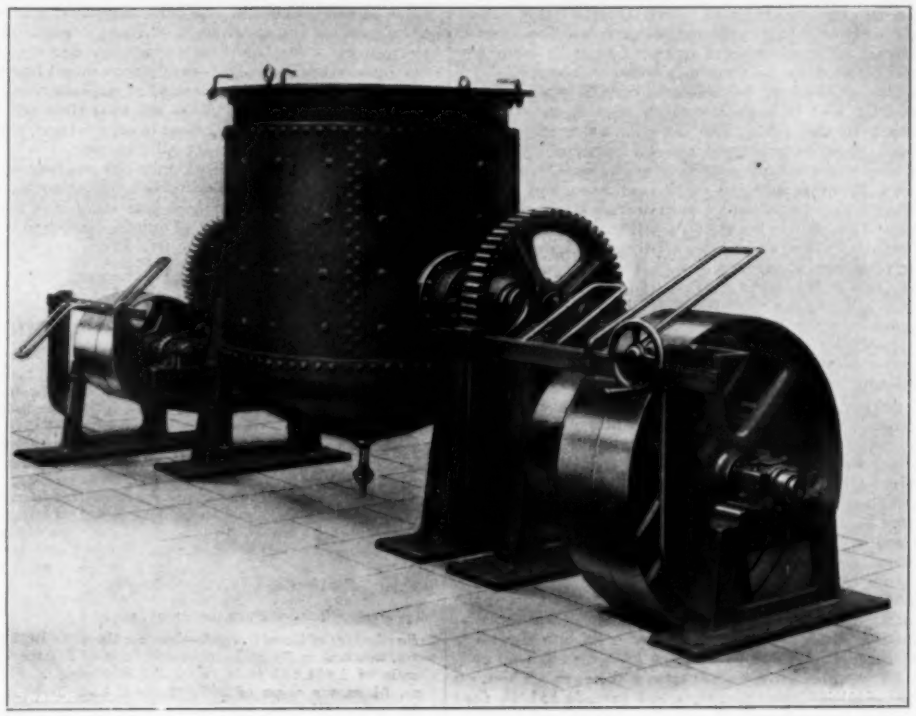


FIG. 4—LINOLEUM-CEMENT MIXING PAN—BERTRAMS, LTD.

a compromise has to be made with holes about ¼in. in diameter. After the oil has been circulated through the apparatus for about seventy-two hours, during which time the temperature is carefully regulated, and a supply of air is provided by a fan to carry away fumes, valves in the pump delivery are manipulated and the charge is transferred to an overhead tank. There is a separate tank for each cylinder.

It is not practicable completely to oxidise the oil by the raining process, on account of its viscosity,

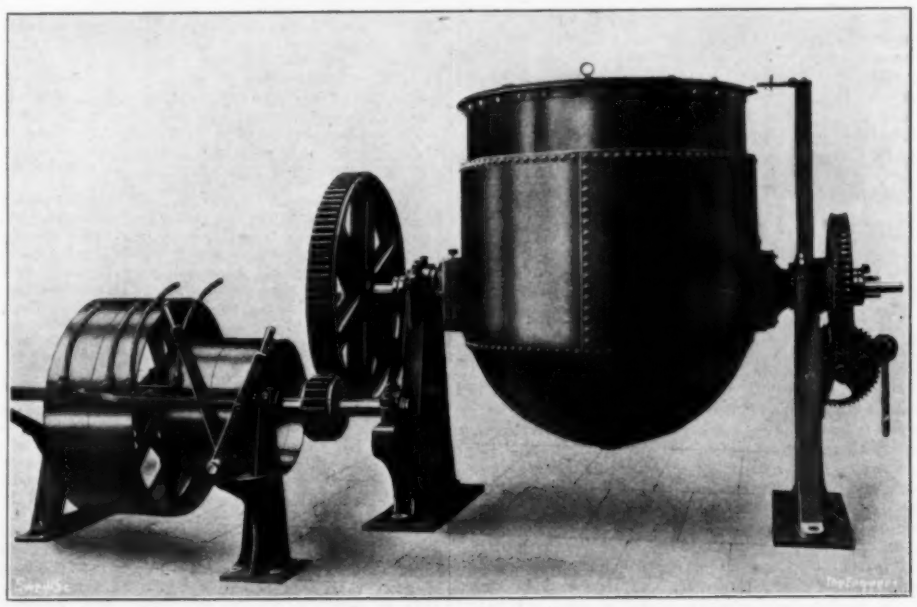


FIG. 5—LINOLEUM-CEMENT MIXING PAN—MELVILLE-BRODIE

so it is transferred to another apparatus for further treatment. In this case a horizontal cylinder is used, and inside there is a rapidly rotating shaft equipped with beaters. The cylinder is jacketed and can be heated with steam or cooled with water, as required. On the front of the cylinder there are two air inlet pipes and air is sucked in through them by an extractor in a ventilating pipe. In some works the air is forced in instead of being sucked through, but it is generally agreed that the latter system is preferable, as the draught through the inlets is a ready indication that everything is going on well. At this stage a small proportion of powdered chalk is mixed with the oil to neutralise any acid it may contain.

After being treated in the beater for about a day, the batch is run out on to the floor to cool, when it becomes a tough spongy mass of a golden yellow colour. Men cut up the stuff with spades, into cakes about a yard square by an inch thick, and put the cakes into separate metal trays. The trays are then wheeled into ovens and baked for several days. During this process the chalk continues to react with the acid and the cakes rise, just like bread, to about twice their original bulk, and assume a slightly darker colour. The cakes are finally stacked in bins for a few weeks to mature, and are then ready for conversion into cement.

One of the important considerations in the working of this process is the careful regulation of the temperatures, and permanent thermometers are therefore fitted on all the apparatus. It is, for instance, necessary, if the oil has been worked at a low temperature at any part of the process, to keep to a correspondingly low temperature at subsequent stages. Any effort to expedite the oxidation by raising the temperature would spoil the cake. This system of oxidation, it will be seen, economises time considerably, as compared with the skin process, but still occupies about two weeks. It also has the advantage that better control can be effected and that a more uniform product is made.

The third principal system of preparing the oil is

the Taylor process already referred to, which is in the nature of polymerisation rather than oxidation, and is used in the production of the cement for making corticene and cork carpet, as distinct from linoleum.

The oil is first boiled with dryers in externally fired pans at a temperature ranging from 600 deg. to 620 deg. Fah., according to its flash-point. It is noteworthy in this connection that there is a considerable risk of the oil catching fire through boiling over into the furnace, and for this reason the boiling is carried on in a shed well separated from the rest of the buildings in the factory. When the oil has been raised to the required temperature a pipe is lowered into the pan, and air is blown through the charge by means of a Roots blower, while a hood connected with an exhausting fan is arranged to carry away the fumes, or toxins, as they are called in the trade. A certain amount of oil spray is carried over by the draught, and is precipitated so that it may be returned to the pan. The aeration is continued for about eight hours, until the oil begins to thicken. At this stage the air pipe and hood are disconnected, and a small proportion of melted rosin and gum is added. The temperature is raised to about 620 deg. Fah. The charge begins to froth over and the froth is collected in a small pan alongside. An attendant has to stand by during this part of the process and ladle the stuff back from the small pan into the boiler. After a time the frothing subsides, and the charge becomes a heavy, thick, dark brown liquid. The pan is then picked up by a crane and its contents are tipped out into a shallow concrete tank, dusted over with chalk, to cool down. Each charge weighs about 15 cwt.

In carrying out this process, it is usual to rely on the experience of the attendant to maintain the proper temperatures, and a skilled man is remarkably efficient in maintaining a consistent quality of product, but it is obvious that there will be slight differences in the various charges. A well-boiled specimen of cement, when it has cooled down, is a dark ruby colour, and is very elastic, while it has a somewhat spongy structure. A less satisfactory charge will be softer and more tacky. The charges are cut up in the concrete tank into slabs and are laid out on floors to mature. In some works making corticene the oil is first boiled in a large boiler, containing from 50 cwt. to 60 cwt., and is blown for several hours. Then, on the next day, the contents are transferred to four smaller boilers, where the process is finished, as described above. In this way 3 tons of oil can be "turned" in two days by five boilers, instead of requiring eight boilers, as would otherwise be the case.

In the Wood and Bedford process, which is adopted in some works, the oil is oxidised in steam jacketed pans in from eight to ten hours, and although the product is less binding than the oil made by other processes, it is suitable for many cheaper grades of linoleum.

While most linoleum factories concentrate on one or another of the several processes we have described, some works adopt them all and take advantage of the different characteristics of the cakes to make mixtures, suitable for special purposes, in preparing the cement. Again, other works adopt systems of oxidation which embody only partly the principal processes. In every case, however, the next operation of mixing the cement is practically the same. That is, with the exception of the Taylor process, which produces the cement directly.

The slabs of oxidised oil are taken to a machine, somewhat like a "crocodile" tobacco chopper, that cuts it up into thin slices. These slices, together with a certain proportion of melted rosin, are fed between corrugated rolls, which mash up the mass into a pulp. It is then passed on to large steam-jacketed pans, mixed with powdered kauri gum, and heated for several hours at a temperature ranging about 275 deg. Fah., during which process it is constantly stirred by mechanical means. We give illustrations, in Figs. 4 and 5, of two cement-mixing pans, one by Bertrams, Ltd., of Sciennes, Edinburgh, and the other by the Mellville-Brodie Company, of Kirkcaldy. The jacketed pan, it will be seen, is mounted on trunnions, so that it can be tipped to discharge the contents, and in the case of the Bertram pan a belt-driven tipping gear is provided. A shaft runs through the trunnions and inside the pan it carries a stirrer. The stirrer is generally a circular grid, with diagonal bars, and is driven by belt and the gearing shown. The reason for having two driving speeds is the stiffness of the mixture at the start and finish of the run. When the charge is first put in, it is practically solid, and is merely tumbled about in the pan. As the temperature rises, however, the material becomes liquid, and then the faster drive is used. Finally, the cement gets thicker, and the slow drive must be reverted to. It should be noted that in the case of the Mellville-Brodie pan, the bottom is truly hemispherical, so that it fits snugly round the stirrer.

The operation of boiling converts the charge into a thick plastic mass, of a deep brown colour, which is tipped out into containers to cool. The containers may hold from half a ton to a ton apiece, and are dusted over with chalk to prevent the cement from adhering. When the charge has cooled down, it is cut up into slabs of a convenient size for handling, and is spread out on chalk-dusted floors to mature.

This material is the cement for mixture with the granulated cork, and a careful record is kept of each batch as it is put away on the maturing floors, so that various qualities can be kept separate or mixed, as required. It is very similar to soft rubber in many of its characteristics; that is to say, is very tough and springy, and has a high binding power. The cement made with oil oxidised on the skin process naturally contains a certain amount of fibrous material, as, although the scrim cloths "perish" during their long stay in the oily skin, they still are fibrous, and these fibres are worked up into the cement. For this reason skin oil is not approved of by some manufacturers in the production of inlaid linoleum with sharply defined patterns, although it is admirably suited to the making of the granular inlaid material, in the production of which the Staines works stand pre-eminent. At the Staines works, nevertheless, large quantities of straight-cut pattern inlaid linoleum are made, and the scrim method of oxidation is used throughout, as the proprietors say that they are convinced, after numerous trials of other systems, that it produces the best cement for all purposes.

So far, we have described only the making of the cement which is used to bind together the cork to form linoleum. The preparation of the cork is a totally different kind of industry, and will be described in the next article.

Lloyd's Register: Annual Summary.

LLOYD'S annual summary of the merchantile shipbuilding of the world for the year 1925 has just been published, and following our usual custom, we give below a *précis* of its contents. It will be remembered that this summary does not include warships, and that it takes into account only merchant vessels of 100 tons gross and upwards that were launched in 1925, whether they were completed during the year or are still under construction. Sailing vessels fitted with auxiliary power are included with steamers or motor ships, according to type of engine. Returns are not available as regards Germany and Austria-Hungary for the war period—1914–18—nor as regards Germany for 1919 and 1920.

GREAT BRITAIN AND IRELAND.

Particulars of Total Output.—During the year 1925 there were launched in Great Britain and Ireland 342 merchant vessels of 1,084,633 tons, viz., 272 steamers of 811,558 tons, 51 motor ships of 267,217 tons, and 19 barges of 5858 tons. All these vessels are built of steel, with the exception of one composite and two wood vessels, of 432 tons. Not a single sailing vessel was launched during the year. The output for 1925 is 355,252 tons lower than that for the year 1925. The present total represents 49·5 per cent. of the world's output for 1925, as compared with 64·1 per cent. in 1924, 39·2 per cent. in 1923, and 58 per cent. in 1913.

Nationality of Vessels Launched.—Of the tonnage launched during the year, 906,169 tons are for registration in Great Britain and Ireland, and 178,464 tons—under 16½ per cent. of the total tonnage—are for owners residing abroad. This percentage compares with under 15½ per cent. in 1924, less than 3 per cent. in 1923, 26 per cent. for 1922, and an average of over 22 per cent. for the five pre-war years 1909–1913.

Size and Type of Vessels.—The returns for 1925 show that 75 vessels of between 5000 and 10,000 tons each, and 12 vessels of 10,000 tons and upwards, were launched. The following are those of 15,000 tons and upwards:—Conte Biancamano, 22,883 tons; Asturias, 22,137 tons; Carinthia, 20,277; Otranto, 20,032 tons; Caledonia, 17,046 tons; Transylvania, 16,923 tons; Ranchi, 16,650 tons; Rawalpindi, 16,619 tons; Rajputana, 16,568 tons; Chitral, 15,248 tons. Excluding vessels of less than 1000 tons, 24 vessels of about 134,766 tons, for the carriage of oil in bulk, were launched during 1925. Of them, 15 vessels of about 98,700 tons were built on the Isherwood system of longitudinal framing. Eight vessels with corrugated sides, with a total tonnage of 39,453 tons, were launched during 1925. The tonnage of steamers fitted for burning oil fuel, launched during the year, amounts to about 293,000 tons. The returns include a number of vessels designed for channel, coasting, fishing, towing, harbour service and other special purposes. The average tonnage of steamers and motor ships launched during the year was 3340 tons. If the vessels of less than 500 tons are excluded, the average is increased to 4439 tons, as compared with 3777 in 1924, 3805 in 1923, 5186 in 1922, and 4602 in 1921.

Vessels Fitted with Turbines.—Further progress was recorded in the use of steam turbines during 1925, when 17 vessels with a total tonnage of 164,889 tons, were launched, which will be fitted with that method of propulsion, and all of them, with the exception of one of 664 tons, will have geared turbines. It may be stated that of the vessels of 15,000 tons and upwards launched during the year, five are to be fitted with turbines.

Vessels Fitted with Internal Combustion Engines.—The number and size of vessels fitted with internal combustion engines are steadily increasing. During 1919 the tonnage of such vessels launched was 32,936 tons, while in 1924 it amounted to 237,458 tons; and during 1925 51 motor ships of 267,217 tons were launched, and 34 of them are of 5000 tons and upwards, the largest being the Asturias, of 22,137 tons. The tonnage of the motor ships launched during the year amounted to nearly one-third of the steam tonnage.

Output of Leading Ports.—The Clyde district occupies first place amongst the shipbuilding centres, showing an output of 506,717 tons. Then follow the Tyne, 194,614 tons; the Tees, 96,660 tons; the Wear, 91,581 tons; and Belfast 57,506 tons. The largest decrease, as compared with 1924, took place on the Wear, the figures for which were 102,494 tons lower than in the previous year. The decrease on the Tyne amounted to 81,058 tons, on the Tees to 64,851 tons, at Belfast to 47,884. On the Clyde the decrease—25,355 tons—only amounted to 4¼ per cent. of the production for the year 1924.

Progress of Shipbuilding during the Year.—As regards the movement of the shipbuilding industry during the course of 1925, Lloyd's Register quarterly returns show that at the opening of the year 1,296,971 tons were under construction in Great Britain and Ireland. The returns issued during 1925 showed a steady decrease throughout the year, and on December 31st, 1925, the tonnage under construction in Great Britain and Ireland only amounted to 885,013 tons, 411,958 tons less than twelve months earlier. The figures for the end of 1925 are the lowest recorded since September, 1909, and show a reduction of 2,913,580 tons, as compared with the record reached at the end of March, 1921. It should also be stated that at the end of 1924 the totals included about 60,000 tons on which work was suspended, while at the end of 1925 such tonnage had been increased to 97,000 tons. Moreover, the orders for new vessels—judging by the tonnage commenced, as shown in Lloyd's Register quarterly returns—have in no way kept pace with the tonnage launched.

OTHER COUNTRIES.

Particulars of Total Output.—There were launched abroad during the year 513 merchant vessels of 1,108,771 tons—272 steamers of 487,138 tons, 147 motor vessels of 576,412 tons, and 94 sailing vessels and barges of 45,221 tons. The figures show an increase of 300,905 tons, as compared with those of 1919—the record year—and they are 291,958 tons lower than those for 1913, during which year the highest pre-war total was reached.

Size and Type of Vessels.—The returns for the year include 43 vessels of between 4000 and 6000 tons each; 28 of between 6000 and 8000 tons; 21 of between 8000 and 10,000 tons; and 11 of over 10,000 tons each, the largest being the motor ship Saturnia, of about 25,000 tons, launched at Monfalcone. There were launched during the year 12 vessels of a total tonnage of 97,185 tons to be fitted with turbines, all except one being associated with reduction gearing. Of these vessels, 10 are of more than 5000 tons each, the largest being the steamer Hamburg, of 22,000 tons. Excluding vessels of less than 1000 tons, the output abroad for the year also comprised 17 vessels, of about 139,000 tons, built on the Isherwood system of longitudinal framing, of which 14 are motor ships, totalling 130,567 tons. Including 12 of these vessels, of about 100,000 tons, there were launched during the year 24 vessels of about 152,000 tons for the carriage of oil in bulk. During 1925 there were launched 147 vessels of 576,412 tons to be fitted with internal combustion engines, as compared with 99 of 264,340 tons in 1924; 76 of these launched during the year are of over 4000 tons each, including 35 in Germany, 11 each in Denmark and Italy, and 10 in Sweden; the largest being the Saturnia, referred to above, of about 25,000 tons, built in Italy, and two of about 15,300 tons each built in Germany. The total figures include a few sailing vessels fitted with auxiliary power. It may be of interest to note that amongst the motor ships launched in the United States during 1925 are included three vessels with a total tonnage of 2033 tons, which will have electric drive, oil engines being used in conjunction with electric motors. The tonnage of wood vessels included in the year's total was 17,627 tons, as compared with 19,290 tons in 1924, and 1,145,582 tons in the war year 1918, when the tonnage of wood vessels launched amounted to 28 per cent. of the total output. The totals for sailing vessels and barges include a very large proportion of craft which cannot be described as real sailing tonnage. The countries in which the largest output took place during the year under review were Germany, Italy, United States, Holland, France and Denmark. The totals for these countries amount to 904,856 tons, and account for 81½ per cent. of the total output abroad.

Germany.—During the year under review 121 vessels of 406,374 tons were launched in German yards. As compared with the output for 1924, the figures show the large increase of 231,261 tons, and represent nearly 37 per cent. of the total output abroad during 1925. These figures include three vessels of 45,800 tons to be fitted with geared steam turbines; they comprise, also, 56 vessels of 279,410 tons to be fitted with oil engines, including one ship, of 6530 tons, in which reduction gearing is employed. This tonnage equals about 48½ per cent. of the total motor tonnage launched abroad during the year. The totals include 10 vessels of between 4000 and 6000 tons, 23 of between 6000 and 10,000 tons, and seven vessels of above 10,000 tons each, including the steamer Hamburg, of 22,000 tons.

Italy.—The total figures for this country—142,046 tons—are 59,520 tons higher than those for 1924; 21 vessels of 110,006 tons were launched in the Trieste district, as compared with an output of 32,557 tons during the previous year. The totals comprise one motor ship of 25,000 tons—Saturnia, the largest vessel launched abroad during 1925—and 14 vessels of between 5000 and 9000 tons each; 16 motor ships, of 101,479 tons, were launched, and two turbine-engined vessels of 14,200 tons.

United States.—The output for the year 1925, namely, 128,776 tons, was 10,687 tons lower than during 1924 and about 3,947,000 tons less than that of the record year 1919, and with the exception of 1922, was the lowest since 1897. The tonnage launched represents 11½ per cent. of the total output abroad for the year 1925. Of the steam and motor tonnage launched, 38,590 tons were built on the Atlantic Coast, 50,010 tons on the Great Lakes, and 4688 tons on the Pacific Coast. The total figures include one steamer of 7057 tons launched on the Atlantic Coast and six vessels of between 6000 and 9000 tons launched on the Great Lakes. The motor tonnage launched in this country during 1925 amounted to 3886 tons; of oil tankers, of 1000 tons and upwards, only one—1217 tons—was launched. The totals also include, as previously stated, three vessels with a total tonnage of 2033 tons which will have oil engines in conjunction with electric motors for the final drive.

Holland.—The total tonnage launched during 1925—78,823 tons—is 15,000 tons higher than the 1924 figures. As usual, the figures for this country do not include vessels exclusively intended for river navigation, the total tonnage of which vessels often reaches a high figure. Vessels launched of over 5000 tons each included two steamers, of 5105 tons and 5700 tons respectively, one motor ship of 9297 tons, and another motor ship—the Indrapoera—of 10,772 tons. There were launched in this country during

the year 17 vessels, of 31,508 tons, to be fitted with oil engines.

France.—The output for the year—75,569 tons—was 4116 tons lower than the total for 1924, and is nearly 62,000 tons below the average output of the three pre-war years 1911–1913. The total figures include two motor ships of between 5000 and 6000 tons each, one steamer of 12,500 tons, and one motor ship of 13,000 tons, the Pieter Corneliszoon Hooft. Seven vessels of 24,393 tons, fitted with oil engines, were launched in this country during the year.

Japan.—The output for this country—55,784 tons—was 16,973 tons less than that in 1924. The 1925 totals comprised four vessels of between 4500 and 7500 tons each, one of which—4500 tons—will employ turbo-electric propulsion, and two, each of 7200 tons, will be fitted with oil engines.

Scandinavian Countries.—The total tonnage launched in Denmark, Norway and Sweden amounted to 155,823 tons, which total is 35,536 tons higher than the output for 1924. In Sweden there was an increase of 22,539 tons; in Denmark an increase of 9331 tons; and in Norway an increase of 3666 tons. The total figures included 21 motor ships of between 4000 and 10,000 tons, while the largest steamer launched in these countries was of less than 2500 tons. The total tonnage of the vessels fitted with internal combustion engines launched in these countries during 1925 amounted to 117,899 tons.

British Dominions.—The total tonnage launched in all the British Dominions overseas during 1925, namely, 46,078 tons, was about 1200 tons more than in 1924. Of the total figures, 20,817 tons were launched in Canada, 17,050 tons at Hong Kong, and 4286 tons in Australia. The totals included five steamers, of 3000 tons each and over, of which the largest are the Gleneagles, 8386 tons, built at Midland, Ont., and two steamers of 4324 tons and 3800 tons respectively built at Hong Kong.

PROGRESS OF SHIPBUILDING ABROAD DURING THE YEAR.

Dealing with the combined totals for the work in hand in the various countries abroad, a slight increase took place during 1925. At the beginning of the year the tonnage under construction amounted to 1,173,465 tons, and at the end of December the total was 1,184,532 tons, an increase of 11,067 tons. The countries which showed the largest increases were:—Italy, 154,788 tons; United States, 47,037 tons; Spain, 28,625 tons; while considerable decreases have taken place in—Germany, 121,105 tons; France, 29,914 tons; and Norway, 19,896 tons. The returns for the fourth quarter showed that at the end of 1925 the countries abroad having the largest amount of tonnage under construction were:—Italy, 309,578 tons; Germany, 234,145 tons—excluding Danzig with 2668 tons—France, 167,256 tons; Holland, 108,894 tons; and United States of America, 105,211 tons. The total tonnage under construction abroad at the end of 1925 upon which work was suspended amounted only to 16,212 tons, which was much less than the corresponding figure at the end of 1924, and was less than 2 per cent. of the total tonnage being built. The tonnage commenced during the fourth quarter showed a considerable decrease compared with the figure for the previous quarter, and would appear to indicate that, at least in some countries, conditions prevailing in the shipbuilding yards abroad have not maintained their recent level.

SUMMARY OF WORLD'S OUTPUT.

The total output during the year 1925 reached 2,193,404 tons. These figures represent a decrease of 54,347 tons as compared with 1924 and of 1,139,478 tons as compared with 1913, during which year the pre-war world's record output was reached. The output in Great Britain and Ireland represented 49·5 per cent. of the world's output during 1925; a decrease of some 15 per cent. compared with the similar figure for 1924.

Some interesting facts may be gathered from this summary as regards the special types of vessels and machinery included in the output of the year under review. The total launches included 29 vessels of about 262,000 tons which will be fitted with steam turbines. The average tonnage of these vessels exceeds 9000 tons. The tonnage of new vessels which are being fitted with internal combustion engines is steadily increasing. During 1925, 843,629 tons were launched, as compared with 501,798 tons in 1924. The present total represents about 65 per cent. of the world's output of steam tonnage, as compared with about 29½ per cent. in 1924; and it may be stated that the tonnage of motor ships being built in the world at the beginning of 1926 almost equals that of the steam tonnage under construction, as compared with 60 per cent. twelve months ago, thus showing the continued remarkable development which is taking place in the adoption of this system of propulsion.

It will be of interest to compare the total of the world merchant fleets in 1914 with the latest available figures. Disregarding sailing vessels and wood steamers, in view of their comparatively small importance in international trade, the gross tonnage of sea-going steel and iron steamers and motor ships amounted in June, 1914, to 42,514,000 tons, while at June, 1925, the figures reached 58,785,000 tons—an increase of over 16 million tons. A remarkable change has taken place in the total tonnage of some types of vessels included in the above figures. For instance, the tankers, which in 1914 totalled 1,479,000 tons, now amount to 5,384,290 tons; and motor ships, which in 1914 only reached 234,000 tons, now amount to nearly 2¾ million tons—including auxiliaries. A great change has also taken place in the relative use of coal and oil fuel for boilers. In 1914 the tonnage of the steamers fitted for oil fuel was 1,310,000 tons, whilst the 1925 figures show no less than 17,804,122 tons.

The amount of shipping laid up has, of course, a most important bearing on the question of finding profitable employment for the enormous tonnage now in existence. The latest figures which have been published for all countries relate to March, 1925, when nearly 5¼ million tons gross were laid up, over three-quarters of this total being United States vessels. The figures of vessels laid up in Great Britain and Ireland, which were then about 604,000 tons gross, have, however, since been increased to about 919,000 tons gross.

Automatic Train Control in America.

(From a Correspondent.)

AUTOMATIC train control has recently made rapid strides in the United States. Of especial interest is the programme embarked upon by the New York Central Lines, covering the installation of automatic train control on 871 miles of route, embracing some 2398 track miles and calling for the equipment of 1165 locomotives for the special working.

The routes to be equipped are as follows:—Albany–Syracuse, and Buffalo–Cleveland, New York Central Railway; West Detroit–Niles, Michigan Central; Indianapolis–East St. Louis, C.C.C. and St. L.; and Springfield–Rensselaer, Boston and Albany Railway. The longest section covered is that between Indianapolis and East St. Louis, 249 route miles, with 391 track miles. The Albany–Syracuse and Buffalo–Cleveland routes, however, with route mileage of 148 and 183 respectively, rank as the most important of the works involved, embracing track mileage of 675 and 716 miles respectively and necessitating the equipment of 342 locomotives for service between Albany and Syracuse and 265 locomotives for use between Buffalo and Cleveland.

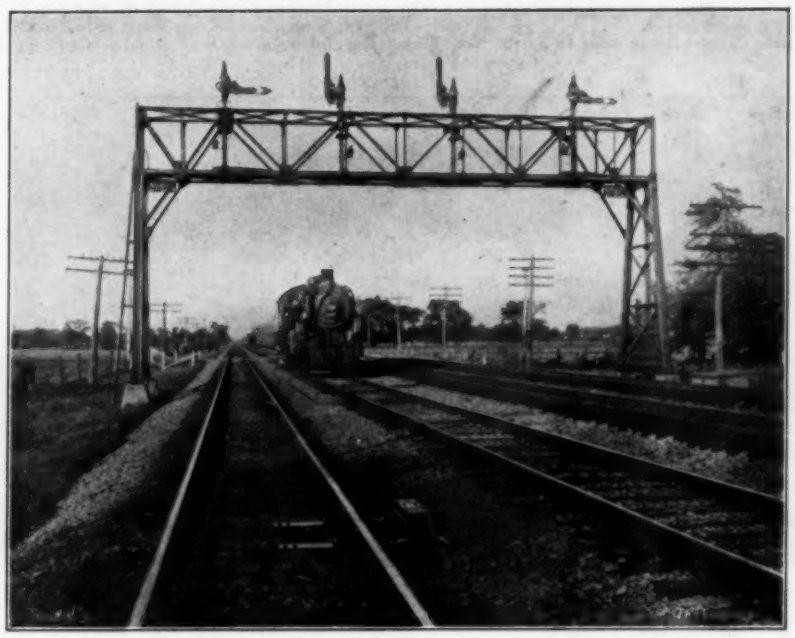


FIG. 1—BRIDGE OF AUTOMATIC SIGNALS, TRACK INDUCTOR IN FOREGROUND

The system of train control adopted is the intermittent inductive auto-manual permissive type developed by the General Railway Signal Company, of Rochester, New York. The object of the system is to enforce the observance of both caution and stop indications of wayside signals by compelling drivers to acknowledge them in passing. Failing acknowledgment, an automatic application of the brakes follows, release being impossible until the train has been brought to a stop.

The apparatus consists of a receiver on the locomotive and an inductor on the track. The receiver is secured to a journal box of the tender, and consists of an inverted U-shaped magnet with laminated cores, large pole pieces and two coils. The track inductor is also a U-shaped magnet with laminated cores and large pole pieces. It rests on sleepers with the pole faces 2½in. above rail top, and the inner vertical face 17¼in. outside the gauge line of the nearest rail. The receiver on the travelling locomotive passes directly over the track inductor, its pole faces being 1½in. above the inductor pole faces.

A short handle, placed within the cab to the right of the driver, forms the "acknowledging" or "forestalling" lever. When passing over the inductor this lever must be operated by the driver to avoid a brake application. If this is not done, the train is stopped automatically. A cab whistle sounds when the acknowledging lever is pulled, and the lever may then be released. Acknowledging must take place, not only before the brakes are applied, but also within a certain definite time before the brake application point is reached. This ensures that the driver is on the alert, and that he has knowledge of the signal indication.

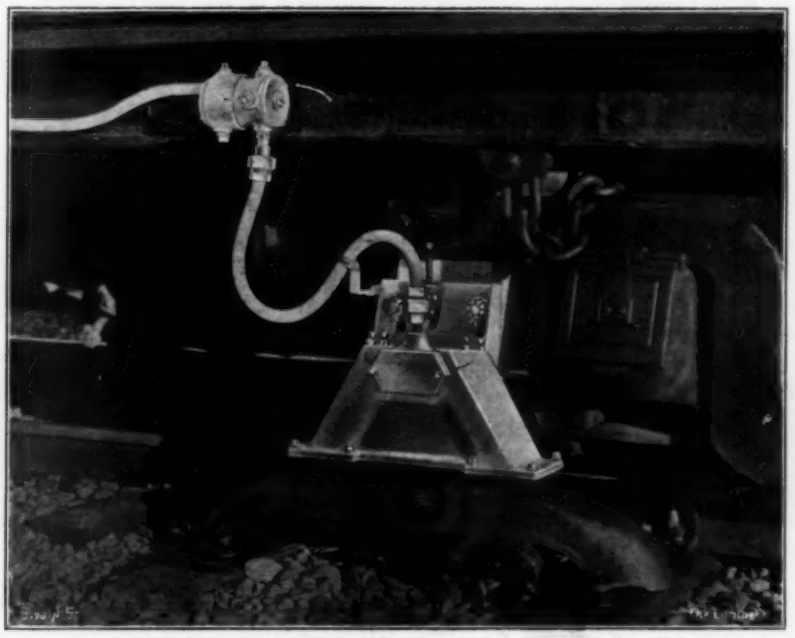


FIG. 2—RECEIVER ON LOCOMOTIVE OVER INDUCTOR ON TRACK

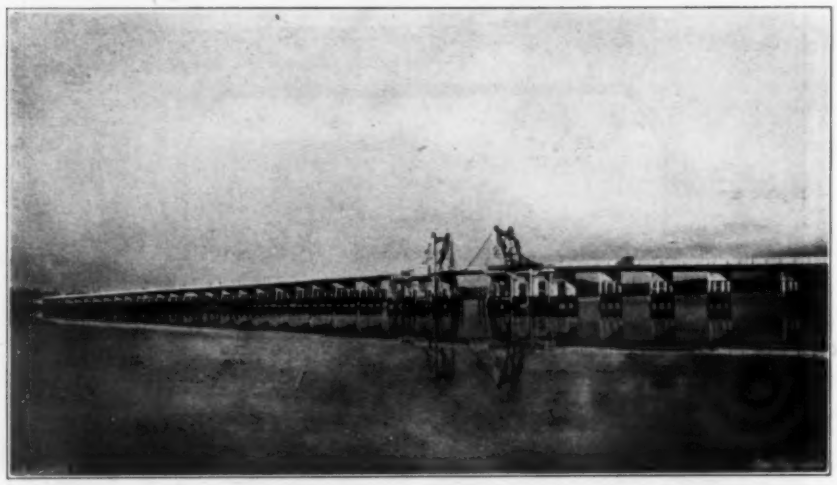
The working of the inductor and receiver is as follows:—The primary coil of the receiver being constantly energised from a turbo-generator circuit on the locomotive produces a strong magnetic field. The secondary coil of the receiver is also connected with the turbo-generator circuit, and is in series with the coil and front contact of a relay through which a small current normally flows. The inductors in the combination are wound and provided with a choke coil automatically controlled. While the signal to which it is connected is at clear, the coil is closed on itself. When the signal is at caution or stop, the circuit opens.

When the receiver on a passing locomotive approaches an unwound inductor, or a wound inductor on an open circuit, a surge of magnetic flux builds up in the secondary coil and produces a negative current in the relay sufficient to allow the relay to open. This causes current to cease flowing to the brake apparatus, consisting of an electro-pneumatic device called a "brake valve actuator." This actuator moves the driver's brake valve to the service position. The actuator has two cylinders, to the smaller

of which under all conditions air from the main reservoir is supplied. When the electro-pneumatic valve is energised, air flows from the main reservoir into the larger of the actuator's two cylinders. The actuator is thereby entirely disconnected from the brake valve handle, so that the driver has the same control of the brake valve that he would have if the actuator did not exist.

Should an attempt be made to run by a signal at "caution" or "stop" without operating the acknowledging device, the receiver, at the instant it passes over the inductor on the track just in the rear of the signal, causes the relay to open, resulting in a service application of the brakes. Under such conditions, it is impossible for the driver to prevent automatic brake application. In Fig. 1 a bridge of automatic signals is seen with a track inductor in the foreground. In Fig. 2 the receiver and the inductor are shown together.

Prior to the decision being come to by the New York Central Lines to introduce this type of train control, some 350 distinct devices were investigated by a special committee established so long ago as 1904. The estimated cost of the new installation is in the neighbourhood of one million pounds sterling.



NORTHERN WAIROA BRIDGE AT DARGAVILLE, NORTH AUCKLAND

Wairoa River Reinforced Concrete Bridge.

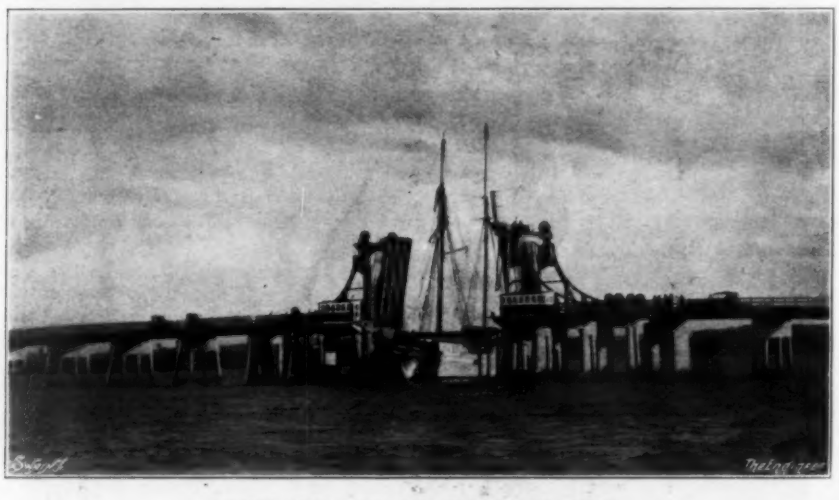
THE official opening of the Northern Wairoa Bridge at Dargaville, North Auckland, New Zealand, took place on November 25th, 1925, the ceremony being performed by the Hon. J. G. Coates, assisted by the Hon. A. D. McLeod, Minister of Lands, and the ribbons being cut by Mrs. F. A. Jones, Mayoress of Dargaville.

The Prime Minister congratulated the district on the completion of the bridge, which, he pointed out, was one of the largest road bridges in the Dominion. It is built of reinforced concrete, steel and hardwood, and is 1578ft. long, with approaches of 15 chains and an opening span of 60ft. to allow vessels to pass the bridge on the journey up and down the river. The total cost, some £60,000, was borne by the Dargaville Borough Council, the Hobson County Council, the Government and the Main Highways Board. The builders were G. M. Fraser and Sons. The first mentioned died during the currency of the contract work, which was completed by his trustees. The bridge, which took over four years to construct, opens up a large tract of rich farming lands, and is a very important link in the main highways system of North Auckland.

With the growth of settlement came not only the necessity for communication with outside districts, but the necessity for intercommunication within the district, and the waterway, provided by the Wairoa River, which was a help to the one proved a hindrance to the other. In a river such as it, in which the tide ebbs or flows at the rate of 2½ knots, the problem of crossing and re-crossing soon proved to be difficult of solution.

The public demand for a bridge was responsible for a conference of local bodies being called, and the Wairoa River Bridge Conference, consisting of delegates from the Dargaville Borough Council and the Hobson County Council, was set up in 1919. Mr. F. E. Powell, A.M.I. Mech. E., M.N.Z. Soc. C.E., consulting engineer of Auckland, was appointed bridge engineer, and prepared plans for a bridge embodying a swing span opening and crossing the river about 60 chains above the Dargaville town wharf to Hore Hore. Tenders received in August, 1920, proved the scheme to be too expensive, and an amended design was proposed and let to the late Mr. G. M. Fraser, a bridge contractor known throughout the Dominion.

The bridge as now completed provides a clear opening span of 60ft. by means of a double-leaf lifting span.



LIFTING SPAN OPEN FOR PASSAGE OF VESSEL

The structure is carried on reinforced concrete piles braced together by means of deep concrete walings and headstocks. Immediately each side of the opening span, which is nearer the Dargaville side, are three spans, each of 20ft., built wholly of concrete and carrying the concrete towers for the lifting of the leafs. The towers are each 28ft. high from dead level, and are heavily reinforced and stayed with reinforced concrete tie bars running from near the top of each tower leg into the concrete deck behind it and down into the steel of the reinforced concrete piles. The lifting spans, which are of steel, decked with timber, are hinged at the abutments and lifted by means of oil engines that are housed at either side of the opening. The lifting winches were constructed by Mason and Porter, of Auckland, and installed by Brown and Sons, of Dargaville. The counterweights travel along curved steel runways, and being connected with the free ends of the lifting leaves, they lighten the load on the engines during the lifting operation.

The end of the Hore Hore leaf rests on a heavy steel box girder at the end of the Dargaville flap, which is connected by means of massive steel links to the top of the Dargaville tower, so that the latter carries the whole weight of traffic and the dead load of the flaps. As an indication of the strength of this portion of the bridge, tests, which were made with a steam road roller, showed that with the roller on the centre of the span, the deflection was only 1·8in., and the deflection only persisted whilst the load was actually on the span. By means of a projecting gangway on the Dargaville leaf and another gangway hinged on the opposite side of the opening, it is possible for the bridge operator to lift or lower both spans within two or three minutes.

In the main portion of the bridge each side from the opening to the river bank the superstructure is of steel and timber, with a bituminous road surface. The steel girders, four to each narrow span and six to each wide span, are 40ft. long. Each girder weighs 4000 lb., and is of rolled steel, 24in. deep, with flanges 7½in. wide. The deck is of Australian hardwood, 4in. thick, and is covered with a depth of 2½in. of bituminous hot-mix wearing surface.

The deck of the bridge provides a minimum width for traffic of 12ft. widening out in three passing places to a maximum of 18ft. To safeguard pedestrian traffic from vehicles, refuges have been constructed at intervals along the bridge.

The bridge has, as has been said, a total length of 1578ft., or nearly 24 chains, and the work, originally let to the late Mr. G. M. Fraser, was completed by Messrs. A. G. and J. R. Fraser, in collaboration with Mr. B. V. Rope, acting for G. M. Fraser's estate. The bridge approaches have a total length of 15 chains.

The lighting of the bridge is effected by town gas. By means of flexible couplings and an auxiliary gas holder on the Hore Hore side, Mr. G. F. Marriott, of Dargaville, has devised a successful method of maintaining the lights on both sides even when the opening spans are lifted.

VIEW ALONG THE BRIDGE

THE DESIGN OF PITOT-STATIC TUBES.

METHODS of air measurement are important for a large number of industries, and especially in any factory or other place in which fans are used to create a draught of air for ventilation. There are many methods of measuring such a flow of air, but the instrument, known as the pitot-static tube, gives, it has been stated, more accurately than any other method the correct velocity of air flow. There is little detailed information available on the characteristics of these so-called pitot-static tubes, which consist of an open-ended tube facing the wind with holes situated in a concentric tube aft of the open end. The openings are normally connected to the ends of a water gauge, and the pressure difference gives a reading proportional to the square of the velocity of air flow.

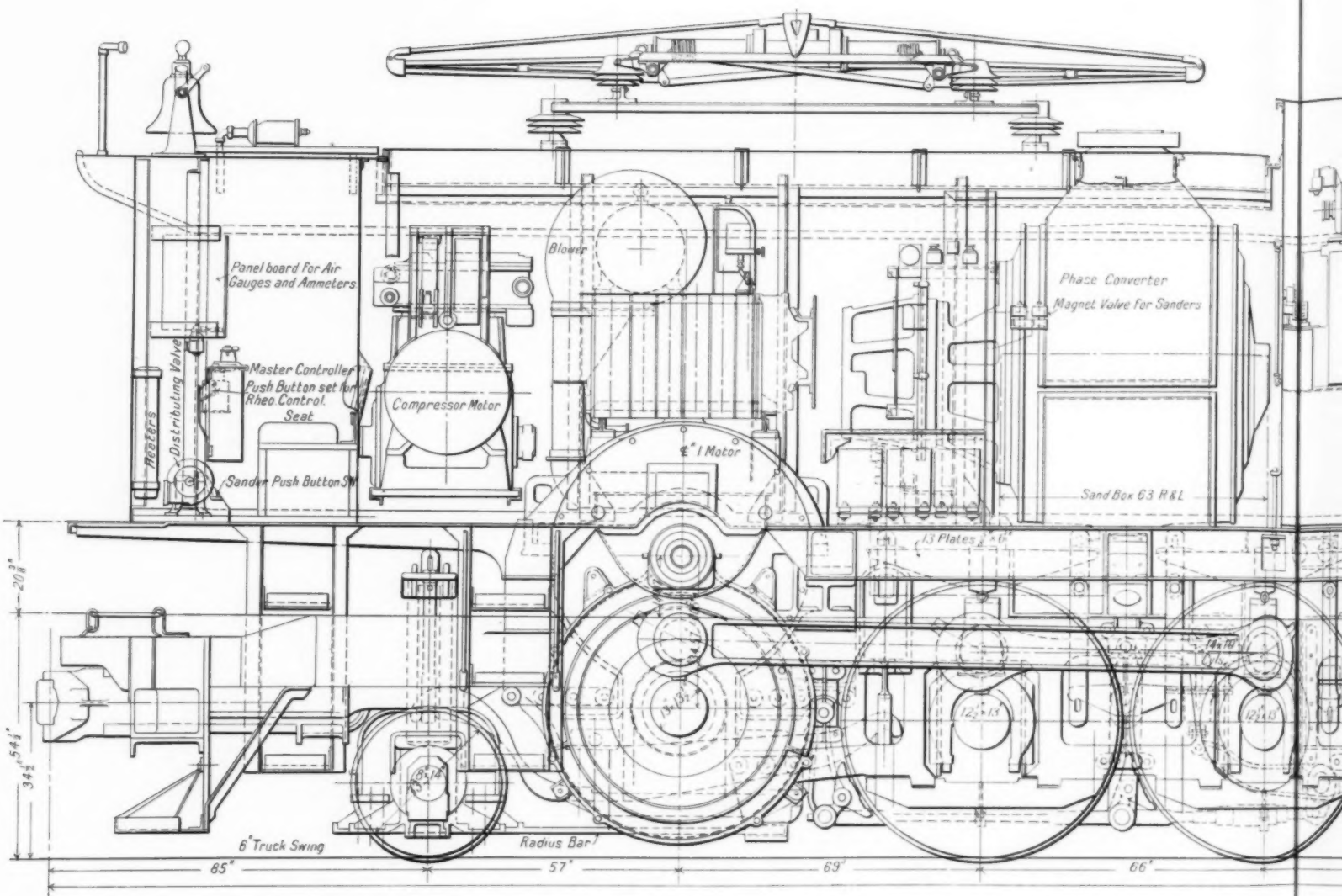
The design of pitot-static tubes is the subject of a report—R. and M., No. 981—by E. Ower and F. C. Johansen, which has just been issued, price 9d. net, by H.M. Stationery Office on behalf of the Aeronautical Research Committee. Experience with the National Physical Laboratory standard instrument has shown, the report states, that although it is very accurate when used under appropriate conditions, it suffers from certain defects. In order to design an instrument in which these undesirable features were eliminated, a research was conducted in a wind tunnel, when the following general conclusions were reached:—The static holes in the concentric tube should be at least six diameters back from the base of the head, and the supporting stem at least fifteen diameters down wind from the holes. In these circumstances, the calibration of the instrument will be, within wide limits, independent of the shape of the head used, and will consequently be insensitive to relatively large variations in the form of the nose. Considerable latitude in the manufacture of duplicates will therefore be permissible without entailing the necessity for such duplicates to be calibrated. Further, an error not exceeding 0·25 per cent. in velocity will be incurred—in place of 0·7 per cent. with the existing standard—if an instrument of this type is used with the stem absent. From both aerodynamic and mechanical considerations, a hemispherical nose appeared to be the most suitable, and that form was incorporated on the modified type of instrument developed as a result of the research. The tests on this instrument are stated to have given satisfactory results; its calibration was found to be 0·3 per cent. on velocity higher than that of the standard, and it was markedly less sensitve than the latter to angular deviations of the wind direction.

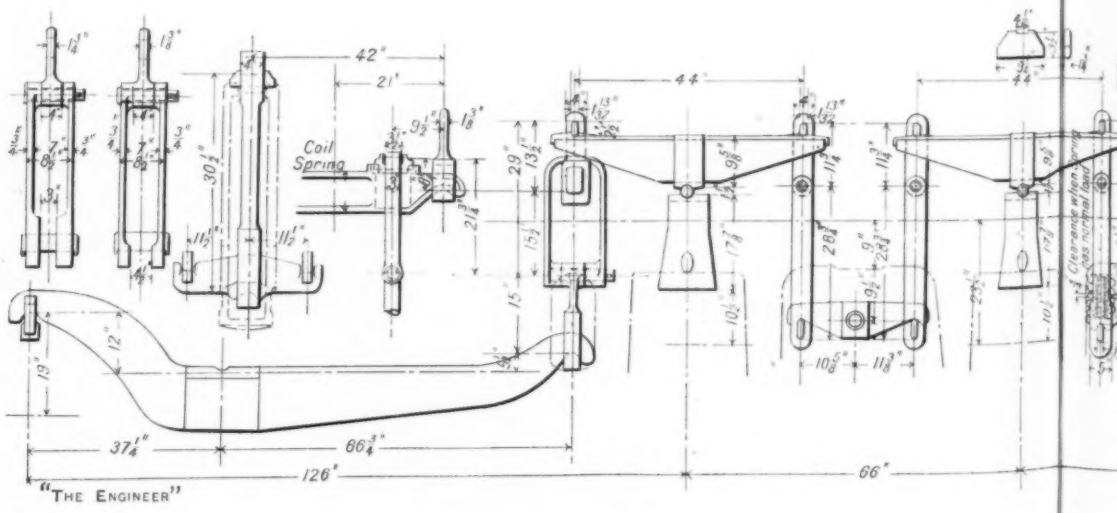
SEVENTEEN bridges on the Catford loop on the Eastern Section of the Southern Railway are about to be strengthened in order to allow the "King Arthur" class of engine to travel *viâ* Denmark-hill, Nunhead and Bellingham to Shortlands instead of *viâ* Herne Hill and Dulwich. The new route will avoid the use of Penge Tunnel, as well as relieving the traffic on that route.

UNIV. OF WYO.

NORFOLK AND WESTERN RAILWAY—4000 H.P

THE AMERICAN LOCOMOTIVE COMPANY, SCHENECTADY, AND THE WESTINGHOUSE

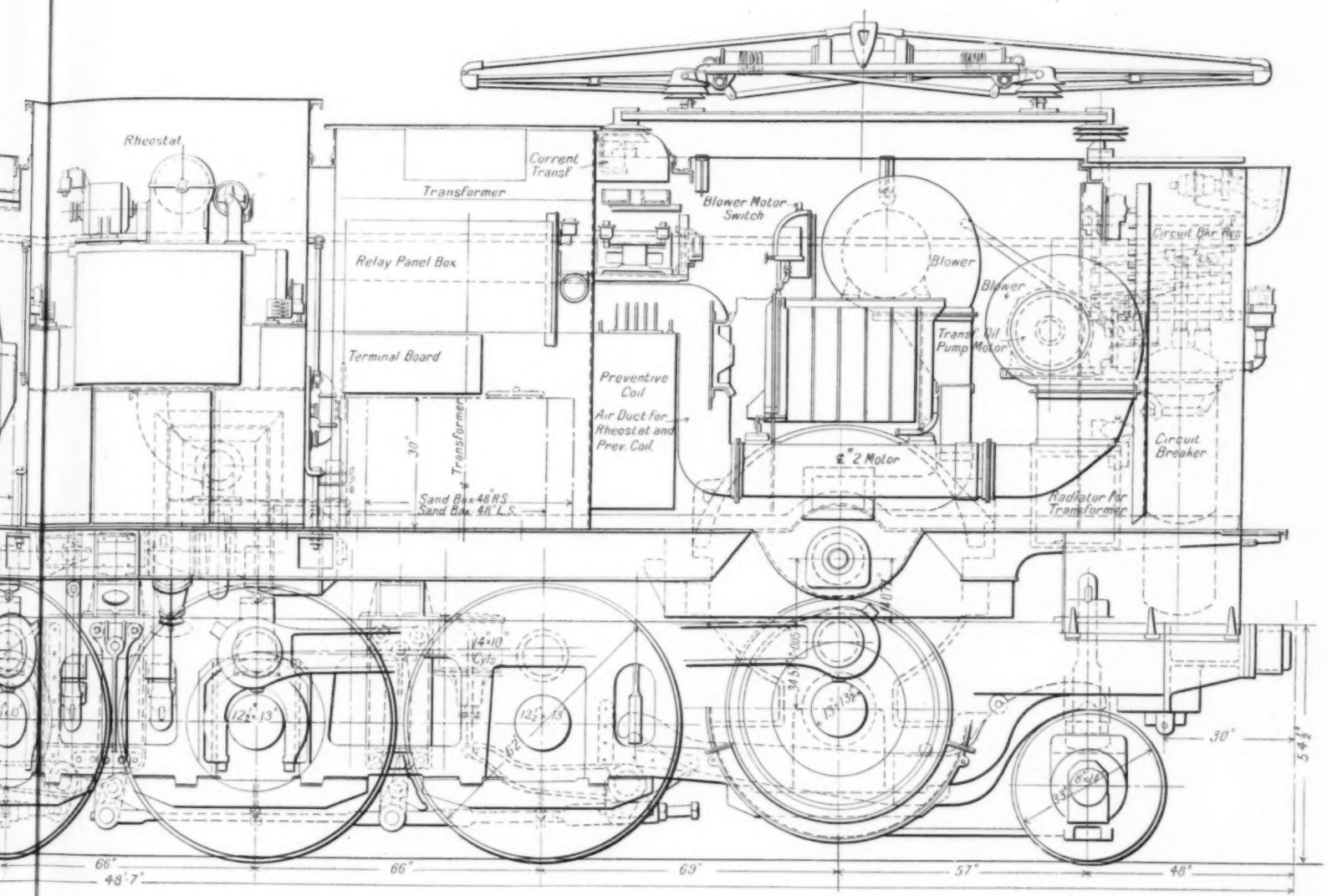


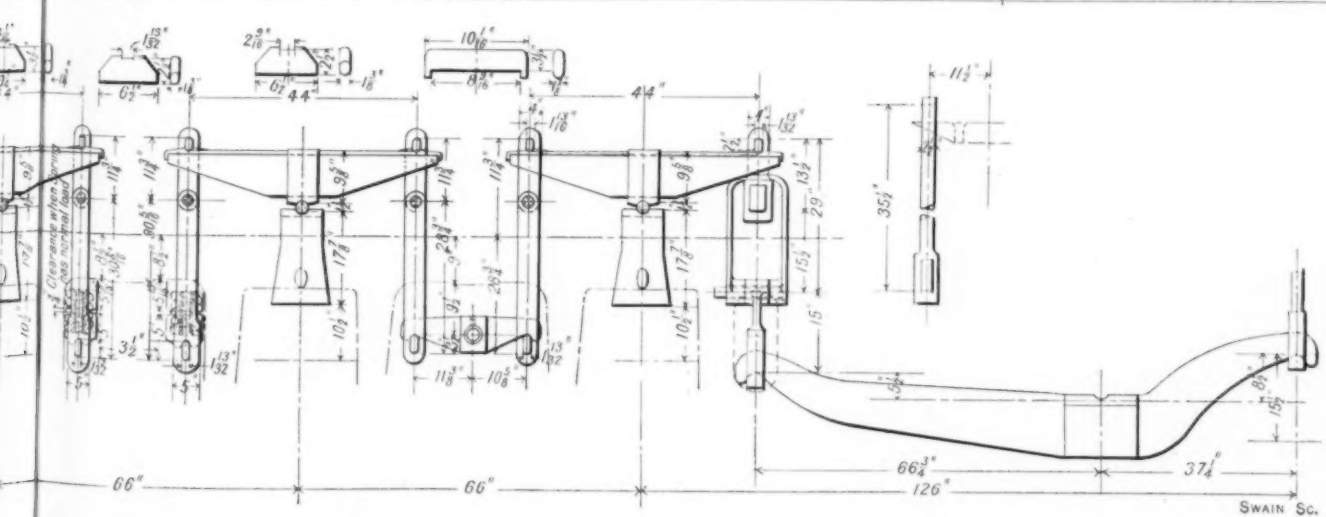


"THE ENGINEER"

4000 H.P. TWO-UNIT ELECTRIC LOCOMOTIVE

WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, PITTSBURG, ENGINEERS





SWAIN Sc.

UNIV OF MICH

Letters to the Editor.

(We do not hold ourselves responsible for the opinions of our correspondents.)

WATERLOO BRIDGE.

SIR,—The subsidence last year of a section of Waterloo Bridge has raised an interesting and lively controversy as to whether :—

(1) The part affected only should be rebuilt, leaving the existing structure intact.

(2) The bridge as a whole should be dismantled, and (*a*) re-erected on existing lines and on wider foundations so as to give a wider roadway ; or (*b*) re-erected so as to retain some of the old spans and provide some larger ones for the better passage of river craft.

(3) An entirely new bridge should be constructed.

In all this æsthetic considerations are advanced, as they should be, urging the advisability of keeping this masterpiece of Brunel's intact.

The problem is primarily a traffic one and cannot be solved without regard to the manner in which, not only traffic local to the bridge, but London traffic generally is to be handled in the near and not very distant future.

It has been said that "wisdom is knowing what to do next, knowledge is knowing how to do it, and virtue is doing it." In the matter of Waterloo Bridge the London County Council cannot be charged with conspicuous wisdom in having assumed that it alone is morally charged with authority to come to a decision on this intricate problem.

The determination to scrap may or may not be a correct one ; but the public has a right to a clear and logical statement indicating how much weight has been given to the many-sided issues, of which the following are indicative and cogent :—

(1) The fundamental reason for building a bridge is, of course, to permit of traffic being carried swiftly and safely from one bank to the other ; but, this primary function satisfied, there is no reason why the erection should not be beautiful.

(2) Whether the present bridge be widened or a new one built, it should be adequate to meet the needs of the traffic for many years to come, say, a hundred years. What will the extent and nature of this traffic be ? What quality of mind in one man or body of men is likely to find an answer to this question ? One would hardly admit that the members of the Corporation of the City of London are qualified, because their interests are strictly limited to the care of the bridges spanning the Thames within the City boundaries. Knowledge of, and interest in, London as a whole would, however, be sufficient reason to call them to enter into consultation. Nor can the claims of the London County Council as a body to be qualified be granted, because although it has done wonderful work for London and is the Bridge Authority from Hammersmith to Woolwich, excluding the City bridges, it is not the Traffic Authority of either the County of London or Greater London. It renounced any claim it might have had to being the Traffic Authority when, over twenty years ago, it decided to lay down tramways and entered into competition with other forms of passenger locomotion. It cannot now take a disinterested view of traffic generally. Furthermore, it is not the Road Authority, nor has it any direct and detailed information as to London traffic conditions, better known, as they must be, to the Commissioner of Police and the Home Office than to anyone else.

(3) The question as to what the density of the traffic over Waterloo Bridge will be in the future is closely related to that of the development and electrification of suburban railways and the building of new tubes, especially in South London. Rapid centrifugal distribution of passenger traffic to the suburbs and countryside in the evenings and inversely quick centripetal movement in the mornings to the City and West End by such means will help materially to ease the situation and modify the direction of flow of traffic. Consideration of this problem has forced many to the conclusion that just as, say, electricity is conveyed from a central station by means of high pressure feeders to distant centres and there distributed by a low pressure network, so London traffic must eventually be dealt with by numerous high speed tubes radiating from the area bounded, say, by the Inner Circle Railway. A passenger, alighting at his tube or electrified railway station, would then be conveyed to and set down close to his home by a "distributor" motor omnibus. Very few, if any, motor omnibuses of the "through route" type would be allowed within the crowded areas of the West End or City, but naturally "distributor omnibuses" would serve there also.

(4) No consideration of the problem of Waterloo Bridge is complete without careful consideration of the ultimate function of other bridges and especially of Charing Cross railway and footbridge. What are we, as a nation, going to do about that terrible bit of vandalism ? Obviously it should come down ; Charing Cross Station should be transferred to the south side and a beautiful and stately passenger and vehicle bridge be re erected on or near the present site with a fine open approach to Trafalgar-square.

Having, it is hoped, indicated in some small way the nature of the problem, I should like to add, as a lover of London, that a great opportunity arises now for action worthy of the traditions of our race. The occasion may be judged by asking the simple question : Why should we be forced longer to gaze from the north side of the river on the desolation of the south—muddy banks and wretched, squalid, advertisement bespattered buildings and wharves—while from that side some of the most beautiful city views in the world, both in form and subtle colouring, can be obtained ?

Will this Empire now rise to the greatness and the correspond ing responsibilities of its inheritance and, rising, will it eradicate waste and dedicate part of its surplus energy and will to the stately reconstruction of the south side of Father Thames ? There is no reason why, considered as related to and entering into the solution of this problem, the view from any point along the Embankment looking towards the Elephant, should not be as inspiring as that from the central window of Hampton Court Palace or the prospect of Greenwich Hospital from the north bank of the river. The triangular piece of land bounded by the river and the roads joining the Elephant with Blackfriars and Westminster Bridges or that part nearer the river lends itself to a lay out giving heightened perspective as viewed from the north side. A broad road along or near to the south bank would form a short route from the City to Westminster and would tend to distribute cross-river traffic more evenly over the then four great bridges, Blackfriars, Waterloo, Charing Cross, and Westminster.

The question as to whether Waterloo Bridge should be "scrapped" or rebuilt in the same or slightly modified form to allow of increased river navigating facilities is not the whole question. It is just a factor in a much larger problem, and in the larger problem millions scattered throughout the Dominions who have visited the heart of their Empire are deeply interested.

I plead with others for the formation of a well-informed, high-minded, impartial, expert authority in the shape of a Commission under State guidance to consider this far-reaching problem. If this be done it cannot be said in the future that we of this generation failed to respond fully to the deep and quiet call of London—the love of London. E. W. DICKINSON.

London, January 17th.

THE FUTURE OF THE ECONOMISER.

SIR,—In reference to the leading article on Economisers in the current issue of THE ENGINEER, would it not simplify the problem if the various functions of the steam passing through a "bled" turbine were treated separately ?

In connection with a turbine from which steam is bled to heat water to, say, 325 deg. Fah. there are three separate and distinct functions, or, in other words, the "heat" supplied to the turbine is split up into three separate imaginary streams.

The main stream passes through the turbine performing its full quota of work ; therefore does not affect the problem under discussion. The second stream passes almost wholly through the turbine, but is "bled" for other reasons than heating feed water ; this heating automatically follows as a sort of by-product of this second process. The third stream is bled from the turbine at, say, 82 lb. pressure, not with the object for which the second stream is bled, but purely for feed water heating.

The use of the third stream to any extent would necessitate passing more steam into the turbine than actually required for the power to be generated ; in other words, surplus steam or heat. This surplus heat will have to be produced in a boiler having, say, 85 to 92 per cent. efficiency, and therefore this third stream will involve a thermal loss of 8 to 15 per cent.

The boiler with air heater might show just as high a percentage efficiency, but there will be an additional demand to the extent of the surplus heat required, and this additional demand should be taken into consideration when comparing "economiser" heating with semi-live steam heating.

The article mentions "practical" considerations, and it is in this connection that the economiser should continue to justify itself.

In the first place, considerable strides have been made, both in the design and on the metallurgical side of the cast iron economiser. Such economisers have now been at work in England under pressures of 400 lb. per square inch and are about to be installed on the Continent for pressures well over 500 lb. per square inch. The metal of which they are constructed is of almost double the strength of the old-time Admiralty standard cast iron and has an elasticity unimpaired by its extra tensile strength. The factor of safety under which these economisers are working at 500 lb. pressure is actually greater than the factors of safety in the old days with the standard designs and ordinary metal.

The question of maintenance is an important factor. With high-pressure boilers an exit temperature of 700 deg. Fah. might be considered as the lowest economic limit compatible with reasonable capital outlay. If this gas has to be reduced to 250 deg. Fah. by means of an air heater it means air entering the grates or combustion chamber at over 500 deg. Fah.

With certain classes of coal and methods of firing a CO_2 percentage of 15 per cent. is a not unusual performance. Even without heated air this percentage of CO might produce excessive temperature, but with air entering the furnace with a 450 deg. Fah. increase in temperature it is not difficult to realise the probable increase in maintenance charges of brickwork arches, grates, &c.

In America the use of radiant heat superheaters and water-cooled furnaces has a greater vogue than in Europe, but even then the extra upkeep or maintenance must be considerable, and this will no doubt be evident in a few years time.

There is also the question of the maintenance and power of the extra fans required, the air heaters themselves (in addition to the steam preheaters), and the necessary air ducts. There is no doubt that the conveyance of the necessary feed water to the boiler is a vastly more simple problem than the conveyance of large volumes of heated air—in many cases from the top of a boiler-house to the basement.

The fact should not be overlooked that with present-day feed inlet temperatures—well above the dewpoint of the waste gases—a cast iron economiser should last over twenty years, which is probably four times the life of a mild steel air heater. The writer was shown an economiser at a well-known electric supply station in England (only a few days ago) thirty-two years old, and permission was asked, and may be granted, to increase the working pressure to 175 lb. per square inch.

To summarise the above remarks, is it not better to obtain direct economy by using waste heat to heat water in an economiser which will last many years and absorb practically no power than to generate *extra* steam in the boiler with a consequent loss in efficiency, in order to heat feed water and then be compelled to install additional plant with high maintenance and power costs, and at the same time increase the maintenance charges in the boiler furnace with the sole object of obtaining the same economic chimney temperature as could in the first place be obtained by the more simple economiser ?

January 16th. GEORGE TANSLEY.

TORSION METERS.

SIR,—In reference to your editorial in this week's issue of THE ENGINEER, may I suggest a possible cause of erratic indications of such instruments when used with internal combustion engines on board ship ?

You have the torsion meter placed, in a more or less lengthy shaft, at a point intermediate between a heavy fly-wheel at engine end and a heavy propeller at the other end. Suppose you are on the downward slope of the cyclic speed variation curve, then you have the propeller twisting the shaft forward ("ahead") and the fly-wheel necessarily lagging behind, thus giving a negative (astern) torsion, and this would be deducted from the average torsion corresponding to the average power involved in propulsion of the ship.

On the other hand, let the engine be on the rising slope of the curve, then the propeller has not slowed to the same extent as the fly-wheel during the previous half-cycle and the fly-wheel, being now accelerated, merely overtakes the torsion (negative or astern) and to this extent the torsion meter simply has no torsion to record. Thus on balance, since both effects tend to reduce the torsion of the shaft available to act on the torsion meter, this instrument would show a deficiency. On the other hand, under suitable conditions of engine torque, length of shaft and propeller inertia, the effect might be reversed, giving excess indications. The same effect would no doubt appear in the case of reciprocating steam engines, but for the fact that there is no fly-wheel.

With direct driving turbines no such effect can occur, and with geared turbines only in such cases as set up torsional vibrations in the shafting. GEO. T. PARDOE.

Angmering, January 16th.

THE STEAM LOCOMOTIVE.

SIR,—In your article entitled "The Steam Locomotive," which appeared in the issue of December 11th, 1925, you commented upon the improvements and increased economy of locomotives during a general period of years. That there has been increased economy everybody knows, but, except from compounding, none of this is due to changes in the valves and cylinders, or, in other words, in the steam using parts of the locomotive. Even in compound locomotives these parts have not been improved as thermal machines. The compound principle succeeds in diminishing the wastes of the simple engine, but in detail it is as crude as the latter.

The increased economy of steam of the simple locomotive comes only from increased pressure and the use of superheated steam, and not from an improvement in the thermal qualities of the engine. In stationary engines there is no difficulty in making these improvements, but the locomotive is a difficult subject. The use of the uniflow principle is apparently simple in execution, but whoever tries to apply it to locomotives will find it far from easy. Nevertheless, it will be done. It is very important because it will produce economy without the large cylinders of compound engines or in the number which are used to keep the sizes small.

The cylinders that are now used receive steam of high heat content and then waste quite a portion of it. The higher that content is the greater the waste, and there has been no improvement in, say, sixty years. The use of poppet valves has made some progress, but the defective principle remains even with them, their effect being to diminish steam leakage, which, of course, is of sufficient importance to justify their use.

Boston, Mass., January 5th. F. W. DEAN.

IRON AND STEEL PRODUCTION IN 1925.

IT is reported by the National Federation of Iron and Steel Manufacturers that the production of pig iron in December amounted to 503,400 tons, compared with 494,100 tons in November and 580,300 tons in December, 1924. There were 141 furnaces in blast at the end of the month, the same number as at the beginning, six furnaces having been put in blast during the month and six furnaces either damped down or blown out. The production includes 162,900 tons of hematite, 174,100 tons basic, 115,600 tons foundry, and 23,500 tons forge pig iron. Production of steel ingots and castings declined owing to the Christmas holidays from 653,800 tons in November to 606,800 tons, and compares with 551,000 tons in December, 1924. The December output brings the production of pig iron for 1925 to 6,236,200 tons and of steel ingots and castings to 7,397,300 tons, compared with 7,307,400 tons and 8,201,200 tons respectively in 1924, and 10,260,300 tons and 7,663,900 tons in 1913.

The following table shows the average monthly production of pig iron, and steel ingots and castings for 1913, 1920, 1922 to 1925, and the production each month since December, 1924 :

	Pig iron.	Steel ingots and castings.
	Tons.	Tons.
1913—Average monthly	855,000	638,600
1920—Average monthly	669,500	755,600
1922—Average monthly	408,500	490,100
1923—Average monthly	629,000	706,800
1924—Average monthly	609,900	685,100
1925—Average monthly	519,700	616,400
1924—December	580,300	551,000
1925—January	574,500	605,100
February	541,900	652,300
March	607,900	684,700
April	569,800	597,600
May	574,700	651,600
June	510,300	585,400
July	492,700	590,400
August	444,500	477,100
September	448,700	640,100
October	473,700	652,400
November	494,100	653,800
December	503,400	606,800

VULCANISED FIBRE AND PRESSBOARD FOR ELECTRICAL PURPOSES.

THE new B.E.S.A. publications specified in the title, together with the recently issued Specification for Ebonite for Radio Purposes (No. 234), are the first of a series of British Standard Specifications for electrical insulating materials. The preparation of these specifications has entailed a large amount of research work on the properties of insulating materials, and the values given, together with the methods of testing, have been based on the results of the researches carried out by the British Electrical and Allied Industries Research Association. These methods of testing have been devised for the guidance of all interested to secure, in the first place, the use of the best available methods of test in the development of improved material, and, in the second place, uniformity of practice so that data obtained by different observers may be comparable. Specification No. 231 applies to non-impregnated pressboard only. The preparation of a specification for pressboard impregnated during manufacture with varnish, oil, wax, and the like, is under consideration. Copies of these new specifications may be obtained from the B.E.S.A. Publications Department, 28, Victoria-street, S.W. 1, price 1s. 2d. each post free.

New Locomotives for the Norfolk and Western Railway.

BESIDES its passenger and goods traffic, the Norfolk and Western Railway of America handles an extensive and rapidly growing coal traffic, compelling it to take full advantage of all modern steam traction developments. Careful study of the possibilities of electric traction some ten years ago led to the conclusion, however, that electrification would result in an increased train speed, which, together with the elimination of delays occasioned by coaling and watering of steam locomotives, would enable a greatly increased tonnage to be handled at a reduced cost, whilst giving at the same time a substantial profit over and above the interest and depreciation on the electrical equipment. On one of the most troublesome portions of the railway—a section, with heavy gradients, on which there is a large amount of coal traffic—the company therefore installed electrical equipment, designed to meet unparalleled conditions as regards the power input to trains.

This original electrification scheme was essentially for a heavy gradient east-bound service from the coalfields between Vivian and the division point at Bluefield, over the summit of the mountains at the east; but since this scheme was put into practice two extensions on the low-gradient portion of the line west of Vivian have been made, thus adding 26 route miles of electrified track to the original system, whilst recently a further extension, covering the entire section between Bluefield and Williamson on a low gradient of 16ft. to the mile and adding 46 miles to the present system, has been decided upon. Over this part of the railway trains are hauled by "Mallet" steam locomotives, weighing 2200 tons and travelling at a speed of 20 miles per hour. To obtain the full economies from electrification, it was necessary to improve upon the "Mallet" engine performance, as regards train weight and speed, which involved the construction of electric locomotives capable of developing more power than other electric locomotives in use, whilst the electrification of an adjoining section at some later date will call for more powerful engines still. A new locomotive has been designed to conform with the requirements, and four two-cab engines of this type have been put into service, each engine having approximately one-third more capacity than the original engines, and a greater hauling capacity than any other locomotive that has been constructed up to the present time. On a 2 per cent. gradient trains weighing 4200 tons, exclusive of the weight of the locomotive, are being handled by two split-phase engines, one at the head and the other at the rear of the train.

From the illustration—Fig. 1—and from our two-page Supplement, it will be perceived that the engines are of the two-unit type, with the two parts normally permanently coupled, but capable of being separated for repairs, the wheel arrangement being 2–8–2 + 2–8–2. Two motors are set near the ends of the frame on each portion of the locomotive, and each is connected to two pairs of drivers from a gear-driven jack shaft placed in the frame under each motor, the running gear and motors being mounted directly on the main engine frame.

The main framework of the locomotives consists of two vanadium steel side frames, made up of a single casting, 41ft. 2in. long and 6ft. by 10in. cross section, with integral pedestals for the driving axle boxes and the jack shaft boxes, and is made exceptionally robust in order that it may withstand the severe service stresses on a line with many curves, some of 12 deg. and others on mine sidings of 16 deg. By means of end castings, which are bolted in position, the frames are tied together, the castings carrying the pony trucks, whilst cross ties form the motor supports; there also being cross tie castings which form supports for the phase converter, transformer, liquid rheostat, and other apparatus, and tie the main frames together for practically their full depth.

These cross ties are also bound together by two rolled steel beams running longitudinally between the motors, an arrangement which removes stresses from the light steel structure and confines them to the heavy steel structure, whilst also enabling the load to be carried rigidly on the sub-structure, without the use of swivelling trucks and intermediary springs. Moreover, on account of the position of the jack shafts, outside the driving wheel base, an unbroken side frame construction is provided. The underbed of the locomotive thus forms a rigid box securely tied at numerous points, and carrying all the apparatus, the cab itself forming in effect a box or shell to carry the apparatus and the pantograph on the roof, in which there are hatches, as shown in Fig. 2, to enable all the apparatus to be removed by means of the shop travelling crane. A view of the underframe and running gear is given in Fig. 3.

The three-point spring-equalising system as employed on each of the two units of the locomotive

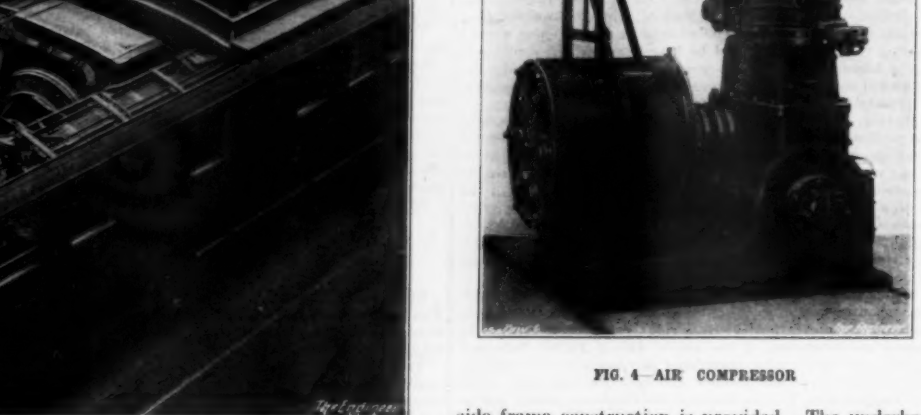


FIG. 3—UNDERFRAME AND RUNNING GEAR

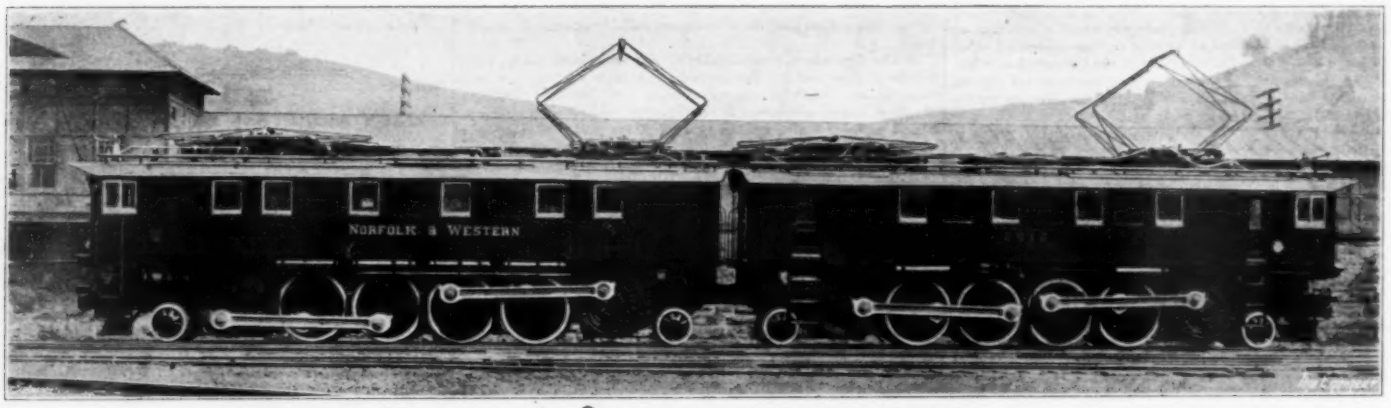


FIG. 1—4000 H.P. TWO-UNIT SPLIT-PHASE LOCOMOTIVE

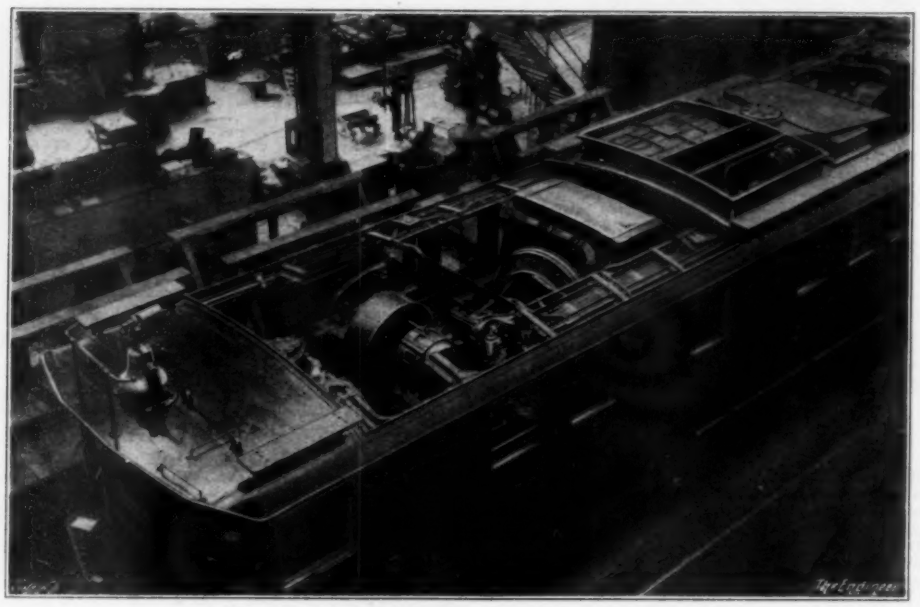


FIG. 2—VIEW OF ONE UNIT OF LOCOMOTIVE WITH ROOF REMOVED

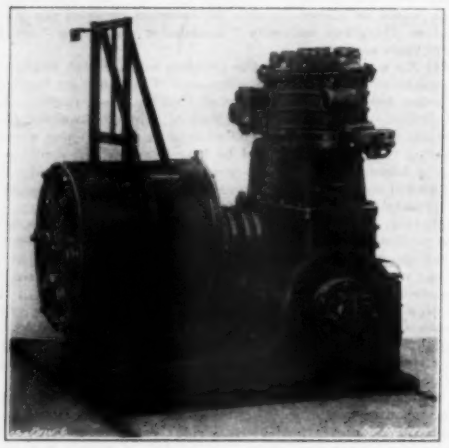


FIG. 4—AIR COMPRESSOR

is shown in the lower part of the Supplement, from which it will be seen that the system involves the use of a combination of bars, hangers and springs as commonly used in America. Compressed air for the brakes is provided by a motor-driven compressor—see Fig. 4—capable of delivering 150 cubic feet of air per minute at a pressure of 130 lb. per square inch to four 14in. diameter brake cylinders mounted on cross tie castings between the side frames, each unit of the locomotive having its own compressor and cylinders. An automatic train brake valve operates

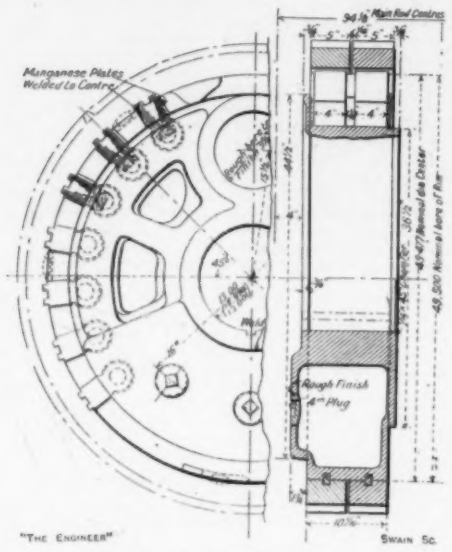


FIG. 5—GEAR WHEEL

the triple valves throughout the train and controls the brakes, whilst an independent straight air valve admits air to the locomotive brake cylinder only.

At each end of each unit of these locomotives there is a two-wheel pony truck, as shown in Fig. 1, with cast steel frames and a radius bar of suitable length for the driving wheel base and maximum curvature. A stabilising arrangement of the Woodward rocker constant resistance type provides for a maximum swing of 7in. each side of the centre, this being sufficient for the sharpest curve, namely, 20 deg., for which the locomotives are designed. Each motor drives through two pinions with twenty-one teeth and a 10in. face, one on each side of the locomotive, and these pinions mesh into flexible gears on the jack shaft. Each gear consists of two rims with a 5in. face mounted on a common steel centre, and they are arranged to revolve through a small angle and are restrained by a series of nests of haft springs inserted in pockets and set radially round the centres, the spring elements—see Fig. 5—consisting of flat bars nested in groups, each group being capable of being removed as a whole. The driving rods are similar to those used on steam locomotives and have floating bushings. The main motors—see Fig. 6—on each unit of the locomotive are forced-ventilated induction machines, each designed to develop 1000 horse-power when supplied with three-phase, 25-cycle current. With the limited amount of space available between the side frames it was found necessary to place the collector rings outside and beyond the pinions; this, of course, necessitated carrying the rotor leads from the windings through a hole in the centre of the shaft. The main motor bearings, which are lubricated with oil rings, consist of a solid cast steel shell with bronze inlays and a Babbitt lining, and they are held in place in taper seats in the housings.

Power from the motors is transmitted through gears with a ratio of 21 : 100, and the 62in. driving wheels give a continuous tractive effort of 90,000 lb. at approximately 14 miles per hour when the motors are connected to work with eight poles, and 52,500 lb. at approximately 28 miles per hour with the motor connections arranged for four-pole operation, the momentary tractive effort under these conditions being 185,000 lb. As the trains pass over different gradients the motors adapt themselves to the work, and power is returned to the line without it being necessary for the driver to turn the controller to the

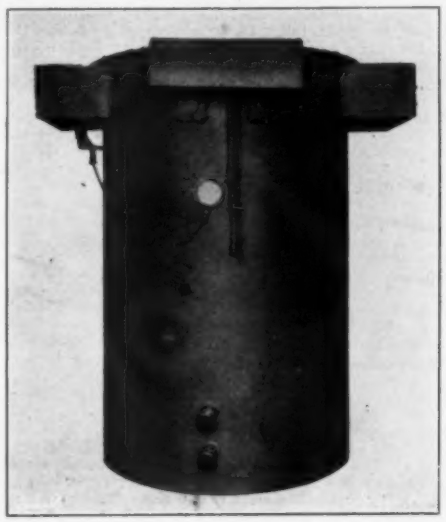


FIG. 8—TRANSFORMER

off position. A movement of the transformer balancing switch lever is all that is required to change from the motoring to the regenerating condition.

For converting the single-phase current collected from the overhead line into three-phase current a phase converter, as shown in Fig. 7, is mounted in the cab of each part of the locomotive, as shown in the Supplement. Each of these phase converters consists of a synchronous rotating machine with a two-phase stator and a wound rotor. One stator winding is fed from the transformer—see Fig. 8—and a voltage is generated in the other stator winding. This voltage is displaced from the transformer voltage by 90 electrical degrees, the pressure on the primary side of the transformer being 10,500 volts. One terminal of the generating phase is connected to the mid-point of the transformer, whilst the other terminal is connected to one phase of the motor circuit. The other two motor leads are connected to leads at the end of the transformer secondary, thus giving a Scott connection for the supply of three-phase current to the main motors. The power factor of the three-phase circuit is improved by the synchronous type converter, but in cases of emergency the converters may be operated as induction machines. Each phase converter is started by means of a single-phase series compensated commutator motor mounted on an extension of the converter shaft, as shown in Fig. 7, and after synchronous speed has been reached the motor is automatically made to act as a direct-current exciter and supplies direct current to the phase converter

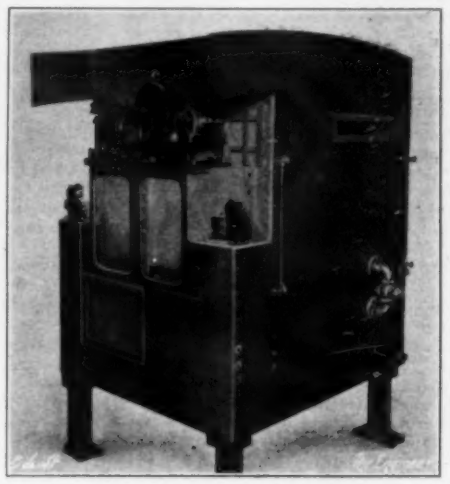


FIG. 9—LIQUID RESISTANCE

rotor windings, thereby improving the power factor.

To enable the main motors to be started from rest a liquid resistance, as shown in Fig. 9, having separate steel plate electrodes, for each phase of each motor, is provided. The electrodes are inserted in and withdrawn from the electrolyte by a motor-driven raising and lowering mechanism, whilst the electrolyte is continuously circulated by a motor-driven centrifugal pump, which draws the liquid from a common storage tank, thus ensuring that all the electrodes are immersed in an electrolyte of the same temperature and density. The electrolyte is led through a cooling tower consisting of a series of trays over which the electrolyte flows in a thin sheet, while cooling air is circulated by a blower over the electrolyte surface. The height of the electrolyte around the electrodes belonging to both the main motors is controlled by a single motor-operated overflow valve. Two pneumatically operated auxiliary valves are arranged so that, in the event of a pair of driving wheels slipping, the electrolyte may be lowered from the

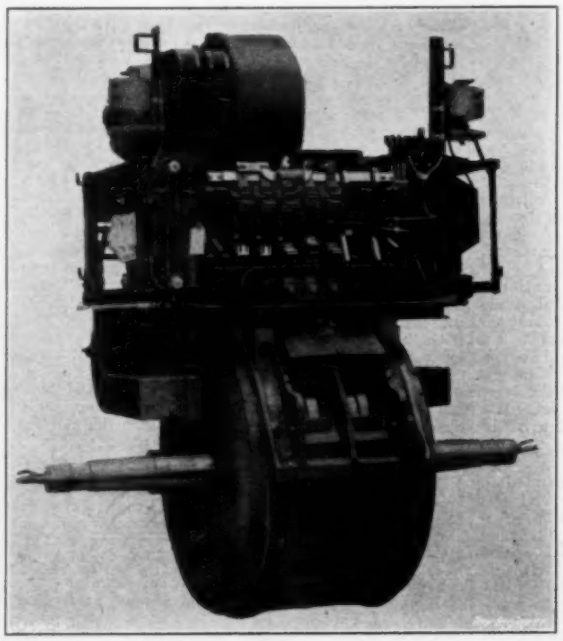


FIG. 6—MAIN DRIVING MOTOR

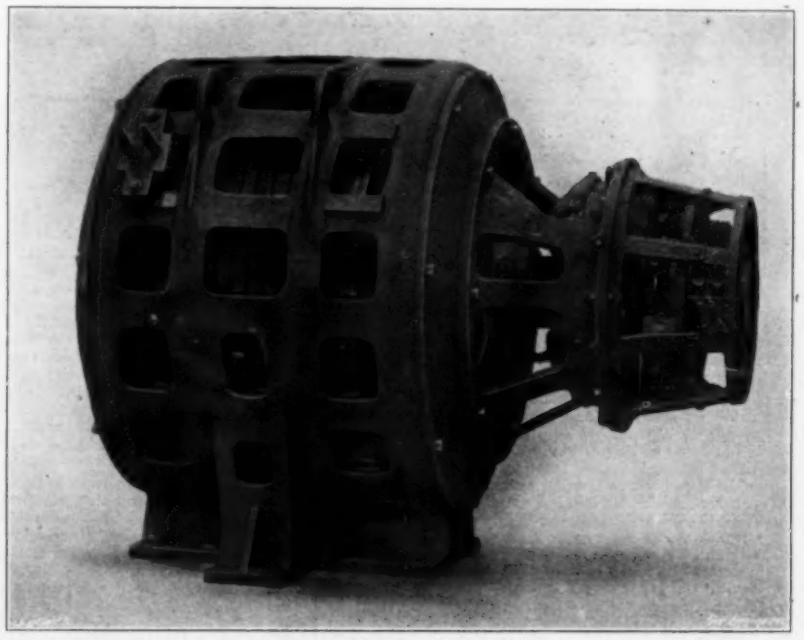


FIG.—7—PHASE CONVERTER

electrodes associated with the rotor of that pair of wheels, by pressing a push button in the motorman's compartment near the master controller. This can be done without affecting the height of the electrolyte surrounding the other electrodes, with the result that the tractive effort of the other motor is maintained. When the drivers stop slipping this auxiliary valve may be closed again, thus allowing the electrolyte to regain its original level. The operating motor is started in

either direction by means of contactors which are controlled in turn directly from the master controller or auxiliary master controller.

In general, the liquid rheostat is of the same type as that used on the other Norfolk and Western electric locomotives during the past ten years, but certain improvements have been incorporated in the design as dictated by experience. The main transformer shown in Fig. 8 is a shell type oil insulated forced cooled transformer, the oil being circulated through an external radiator by means of an auxiliary pump, and is cooled by an air blast from a motor-driven fan discharging directly through the radiator. The transformer is designed to supply the main motors and auxiliaries, when the locomotive is working at the specified capacity, with a temperature rise of 55 deg. Cent. An air-blast type transformer preventive coil compensates for 15 per cent. drop in the trolley voltage and minimises the voltage unbalance during acceleration and regeneration. The use of oil-insulated transformers is a new departure in American electric locomotive practice, and it is expected to result in an improvement over the air-cooled transformer, especially on locomotives operating in places where coal dust is met with.

On the heavy gradient of the electrified line on which these engines are used it is essential for the locomotives to start from the west end of the line with a train of empty trucks weighing 3200 tons and to run west to a point 38 miles distant. At this point the locomotive returns in an eastward direction with a loaded train weighing 4200 tons to a point 10 miles distant, where a pusher locomotive of the same type is brought into use to help the train up the heavy Elkhom gradient to the summit, about 18 miles distant, and from this point the leading locomotive alone takes a 6000-ton train to the west end of the electrified system, but is assisted by a pusher locomotive on the last 3 miles of the journey. When the final section of the line from Williamson to Bluefield is electrified it is expected that trains weighing 2800 tons will be hauled out of Williamson by a single locomotive at a speed of 28 miles per hour, whilst at the foot of the heavy gradient the train weight will be increased to 4200 tons. In co-operation with the motive power department these new locomotives were designed by Gibbs and Hill, consulting engineers to the Norfolk and Western Company. The mechanical portions of the engines were built in the American Locomotive Company's works at Schenectady, whilst the electrical equipment was designed and built in the works of the Westinghouse Electric and Manufacturing Company at Pittsburg.

The leading dimensions, &c., of one of these double-unit locomotives are given in the following table :—

Total weight	828,000 lb.
Classification of wheels	2–8–2 + 2–8–2
Weight on drivers	600,000 lb.
Number of driving axles	Eight
Number of idle truck axles	Four
Capacity at one hour rating	4000 H.P., 14 m.p.h. 4660 H.P., 28 m.p.h.
Maximum starting tractive effort	185,000 lb.
Tractive effort—hourly rating	108,000 lb., 14 m.p.h. 63,000 lb., 28 m.p.h.
Tractive effort—continuous rating	90,000 lb., 14 m.p.h. 52,500 lb., 28 m.p.h.
Maximum safe speed	38.0 m.p.h.
Total wheel base	75ft.
Rigid wheel base	16ft. 6in.
Length overall, between pulling faces of coupler knuckles	97ft. 2in.
Height from rail to locked position of pantograph	16ft.
Diameter of driving wheels	62in.
Diameter of idle truck wheels	33in.
Method of drive	Gears, jack shaft and side rod
Gear ratio	21 : 100
Number of motors	Four

Water-Power in Italy: the Orba Torrent.

THE utilisation of the Orba torrent is the subject of an article in the December issue of *L'Energia Elettrica*, well illustrated by diagrams and many fine reproductions of photographs. The nature of the project as a whole is briefly indicated and a portion of it described. The works present several interesting features. The water power of the Orba valley was studied by Professor Luigi Zunini between 1895 and 1899, and later studies by Ing. Vittorio Gianfran Ceschi led to the adoption of his proposal for the formation of a reservoir of 18 million cubic metres capacity and the carrying out of the necessary works under his direction. Initiated in 1916, the project was financially reorganised in 1922, and the power plant at Molare is to be put into operation very early this year, and by 1927 the remaining works should be finished.

A lucid description of the geology of the region may be summarised as follows:—The Ligurian Apennine region, between Sestri Ponente and Albissola, belongs geologically to the Voltri group or series, and is largely formed of ancient serpentines in numerous lithological forms and associated with hornblendic schists and granites. The main characteristics of the formation are compactness, toughness and resistance to weathering, and there are very few deep fractures. The valley of the Orba begins at the highest end of this region, and passes through its middle zone. The stream has formed valley bottoms of some width where the rocks are relatively soft and unstable, but in the greater part of its course it has encountered tough and stable rocks, and has hewn a deeply sunken bed, sometimes very tortuous, and with sides of naked rock. The characteristics of the Voltri group or series are conspicuous in the glen of the Orba, and planes of contact between instratified rocks are usually sealed tightly, while no appreciable cavities have been found in the rock masses. A test of permeability with cubes of 3 cm. left to soak for fifteen days gave the result, absorption 3 to 9 per thousand. In the catchment of the reservoir, absorption is practically confined to the covering of humus, where it exists.

The catchment of the Orba, upstream of the dam of the Zerbino reservoir or lake, has an area of 141 square kilometres. Rainfall records have not been kept systematically in this region, but there are records of the daily flow of the Orba covering two periods—1900–1905 and 1922–1924. There is a close correspondence between the two sets of diagrams, which show that the year may be regarded as divided into four periods, roughly corresponding to the calendar seasons. In the summer period of four to five months the flow is very small, some 300 litres per second; in the spring and autumn period, each of about three months, the normal flow is about 4 to 5 mecusecs, with occasional freshets and floods; there is also a winter period during which the normal flow of 4 to 5 mecusecs is maintained, without floods. The big floods, which are not easily measurable, may give 700 or 800 mecusecs. The average flow is about 5 mecusecs, which, with the available head of 113 m., will yield about 7500 horse-power. The full project, which includes the provision of two reservoirs, besides that about to be described, is intended to furnish 24,000 horse-power.

The works described in the present article comprise—the reservoir of Ortiglieto; a main dam across the glen; a dam on a saddle, closing a gap in the reservoir basin; the works for conducting the water to the power station; the power station and plant; a regulator dam and reservoir for compensation water; and accessory works, such as the tail-race.

The Reservoir.—The reservoir, or artificial lake, of Ortiglieto lies in a basin of serpentine rock in which there are a few intercalations of other ancient rocks, all impermeable. In form it is a sinuous oblong about 5 kiloms. in length with a maximum width of 400 m. The lowest elevation of the bed, near the dam, is alt. 278 m., and that of top-water level 322 m. Of the total capacity of 18 million cubic metres, all but 93,000 cubic metres is above draw-off level. Unusual interest attaches to the diagram of depths-volumes, for although the lake has been formed by building a dam across the glen, the top-water level is some 12 m. above the lowest point on a saddle, which is closed by the "saddle dam." Moreover, as the lengthwise section of the lake shows, the depth of the lake nearly at its upper end is not much less than in the deepest part, near the dam. For comparison with other diagrams, the depths-volumes curve for Lake Ortiglieto may be drawn as a curve of altitudes-volumes from the following data:—It is formed by straight lines between 6 points found by pairing, in the order given, the altitudes 295, 300, 305, 310, 315 and 322, with the volumes 950,000, 2,350,000, 4,500,000, 7,400,000, 11,250,000, and 18,000,000.

The Main Dam.—The Diga Bric Zerbino is of gravity section, curved in plan to a radius of about 200 m. and built of cement concrete with imbedded blocks, the stone being hard serpentine. In the thicker part of its length there are cavities filled with dry rubble, each communicating with the downstream face by a drain. There are three tiers of these cavities, seen in lengthwise section of the dam as a top row of twelve small tunnel-like sections, at about half-way between foundation and crest; a middle row of eleven similar sections; and a bottom row of eight, about 15 m. above the lowest foundation. There are also two steeply inclined drains, each roughly parallel to a flank of the gorge and extending nearly to the middle of the length of the dam, where it has an outlet on the downstream face. During the building of the dam a tunnel under the river bed was used to pass the flow of the stream and was afterwards filled with concrete.

The provision for surplusing includes a battery of twelve syphons, over the crest of the dam, described as self-levelling syphons on the Heyn system. They are of reinforced concrete, and rectangular in section, 2 m. by 3 m., and have a combined discharge capacity of 500 mecusecs. This device, by directing the water smoothly down the face of the dam, prevents the forming of a cascade and the shock which results when water drops from a height. When the level of the lake rises a little above cota 322 these syphons, which are in groups of three at slightly different levels, come into action group by group. Their entrances being below the surface, the larger flotsam cannot enter and choke them.

Another means of surplusing is an outlet, the entrance to which is a bell valve raised well above the bed of the reservoir, the discharge capacity being 150 mecusecs. There is also at the base of the dam a scour pipe with a capacity of 55 mecusecs. At one end of the dam there is a channel forming a surface outlet, the discharge of which is not allowed to fall directly into the stream near the dam, but is led by a canal along the flank of the gorge to a considerable distance downstream. This outlet has a capacity of 150 mecusecs. There is thus a total surplusing flow of 850 mecusecs from top-water level.

The Saddle Dam, or Dige Sella Zerbino, presented in regard to situation and stability problems quite as interesting as in the case of the main dam. Cross sections of the dam and site show it perched up in a situation obviously calling for great care as regards the measures taken to ensure its stability, and, especially, those needed to secure it against any tendency to slide down the slope away from the lake. One section shows the following altitudes:—Parapet, 325·6; solid crest, 324·5; water level, 322; foundation under the crest, about 310; foundation of upstream toe in trench, about 307·5; and, on the downstream side a series of steps to the foundation of the downstream toe at 298·8. The dam is thus well astride the saddle. The dam is built of the same materials and in the same way as the main dam, and is similarly drained. It is provided with three expansion joints.

The Leat and Pressure Pipes.—At alt. 294 m. the water is taken from the draw-off by a trench excavated in earth, 60 m. long and 4 m. wide, the 1 to 1 sides revetted with masonry and the bottom concreted. The next portion of the leat is a tunnel, in which the water is under pressure. It is of circular section, diameter 3 m., which for the flow of 24 mecusecs gives a velocity of 3·5 m. per second. The length is 2722 m. The balancing chamber is in the form of a well, 10 m. in diameter, excavated in the rock and provided with a separate drain hole. The tunnel continues for about 70 m. beyond the balancing chamber. The pressure pipe is of steel and 423 m. in length, and the diagram seems to show that, as distinct from the lined tunnel, it begins in the tunnel about 40 m. from the daylight end. The diameter is 3 m., reducing to 2·50 m. After serving the first set of turbines it is reduced to 2 m.

The power plant includes two groups of horizontal axis turbo-alternators, Francis reaction turbines having been adopted. Each group works at 500 revolutions per minute under an effective head ranging from 90 m. to 110 m., which, with the flow of 10 to 12·5 mecusecs gives for each unit some 12,500 horse-power. The triphase alternators are coupled directly to the turbines, and the output of each set is 14,000 kilovolt-ampères, the voltage 5000 to a maximum of 6000, frequency 50 periods.

Two transformers, each of 14,000 kilowatts capacity, raise the voltage to 75,000.

The Compensation Reservoir is provided with a dam having the form of a head regulator, with piers and arches, eight spans of 6 m. clear, the piers being 2·0 m. in thickness. There is a roadway over the arches and the piers also support from their upstream ends a steel superstructure of a normal type. The metal sluice gates are counterbalanced, and the work as a whole seems to be well designed for the purpose of supplying readily calculable flows of compensation water.

Locations.—The first reference being made to Genoa, the location of the catchment and works will easily be found. Sestri Ponente is a seaport town, about 7 kiloms. west by north of Genoa. The Tanaro—not mentioned—joins the Po about 16 kiloms. north-east of Alessandria. The Bormida joins the Tanaro, entering that river from the south-east near Alessandria. The Orba rises in the Apennines, and, flowing north, joins the Bormida. Molare is about 36 kiloms. south by west of Alessandria, and the main Zerbino dam is 5 kiloms. from the railway station at Molare. Albissola is about 3 kiloms. from Savona.

SIXTY YEARS AGO.

THE dangers attending seafaring in the 'sixties were undoubtedly very much greater than they are to-day, not merely because modern aids to navigation were non-existent, but because in the construction of ships practices were adopted which at times invited disaster. One such practice, namely, that adopted in connection with the provision of engine-room hatches, was dealt with in a leading article in our issue of January 19th, 1866. These hatches were invariably structures of wood and glass, and as they were simple affairs, not calling in their construction for the display of profound engineering skill, they were left to be made and fitted by ship's carpenters. Many fine vessels, we wrote, had been lost as a direct result of want of attention to this apparently insignificent detail of their design. The duty of an engine-room hatch was commonly considered to be accomplished if it admitted the requisite amount of light and secured the requisite amount of ventilation. In rough weather, with seas rolling inboard, the engine-room hatch, a comparatively flimsy structure, covering a very large opening in the ship's deck, was exposed to severe shocks. On occasion, it would give way and tons of water would pour into the engine-room. Then would follow a fight by the engineers and stokers against the rising waters. Steps taken to prevent the inrush would be all but futile, and in time the water would reach the level of the grates. With the fires put out, the vessel would loose steerage way, settle down and become unmanageable, and, in addition, the engineers would no longer be able to employ the condenser pumps for dealing with the water. The bulkheads would prove of little or no avail. The weight in the already heavily loaded engine compartment would be added to by some hundreds of tons of water, with the result that the ship's frames would be strained and her seams started. Just such a disaster, we recorded, had overtaken the screw steamer London in the Bay of Biscay on January 11th, while on a voyage from the Thames to Melbourne. Of the 270 people on board, but twenty were saved. One of the survivors was the chief engineer, from whose report it was clearly evident that the original cause of the disaster was the carrying away of the engine-room hatch and the failure of all efforts to stop the inrush, and to bale the ship with buckets. On the succeeding day the 3000-ton steamer Amelia, bound for Malta and Alexandria, was lost from an almost precisely similar cause. In her case, the water reached and put out the boiler fires, not by way of the engine-room hatch, but through the coal bunker openings, the lids of which had been washed off. All on board this vessel were saved by the steamer Laconia, which lay by the Amelia during the gale. We refrained from making any suggestions in the matter, for to make them should, we wrote, be needless, but contented ourselves with enforcing on every engineer, naval architect and shipowner the absolute necessity of keeping engine-rooms dry.

THE British Engineers' Association reports a steady tendency to improvement in the volume and value of inquiries for machinery, plant, engineering products and accessories of all kinds from overseas. Several large schemes in progress in the Dominions call for substantial electrical and other machinery and plant. New Zealand's demands in connection with her hydro-electrical developments in particular are of a heavy character. South African railway and harbour developments entail the placing of extensive contracts for cranes and workshop equipment, including boring and turning mills, cropping, tool grinding, planing and milling and shaping machines, lathes, &c., and one for 500 railway wagons. Another inquiry from that country is for complete equipment for a jam factory. South America has asked for quotations for 23,250 electric meters in connection with electrical developments in one of its more important cities. The State Railways of Siam have placed an inquiry for 155 railway wagons.

Railway Matters.

THE vacant position of works manager at the Dundalk locomotive, carriage and wagon works of the Great Northern of Ireland has been filled by the appointment of Mr. R. W. Meredith, the assistant works manager at Inchicore, Great Southern of Ireland Railway.

WHAT would appear to be a reasonable complaint appeared in *The Times* of the 16th instant. The writer, alluding to the fine third-class corridor coaches on the boat trains on the Southern Railway, said that their use was confined to passengers travelling third class throughout. Thus one is not allowed to be satisfied with third-class in England if wishing to go second-class on the Continent. Yet a passenger who travels first class on the boat may go second on the train.

A CHANGE has been made in the running department of the North-Eastern area of the London and North-Eastern Railway. Mr. J. H. Smeddle will continue to be running superintendent and have his headquarters at York. He will have two assistants, both of whom will be stationed at York. One will be Mr. C. M. Stedman, who has been assistant to Mr. Maclure, the running superintendent of the Southern Area, and the other will be Mr. H. J. Stephenson, Mr. Smeddle's assistant at Gateshead.

THE directors of the London and North-Eastern Railway, at a meeting on the 8th inst., placed orders for 33,000 tons of steel rails. As the magnitude of this transaction has attracted attention, we would remark that the quantity named is only about one-half of that used in a year. One of the requirements of the Railway Companies (Accounts and Returns) Act, 1910, is that the quantity of rails used during the year is to be given. In 1924—the last return—the L. and N.E. returned 62,307 tons, the L.M. and S. 72,032 tons, the Great Western 33,660 tons, and the Southern 30,819 tons.

SOME four or five years ago the National Union of Railwaymen, feeling that the credit of its members was at stake, undertook, at its own initiative, a campaign against pilfering. It is therefore satisfactory to note that the chief of the Great Western police said at a dinner on the 8th instant that the depredations committed by railway servants had decreased in a gratifying manner. The solicitor to the company said, on the same occasion, that the record of prosecutions among their servants showed that nearly all the delinquents were men who had been taken on in a hurry to fill the places of those good men who went to the war.

SPEAKING in Belfast on the 12th instant, Colonel Wilfred Ashley, the Minister of Transport, said that the railways were having an anxious time, but he was convinced that when trade revived, and it was reviving, the railways would return, if not to their prosperity of thirty years ago, at any rate to a reasonable measure of prosperity. The ideal thing was to combine road transport with railway transport. There was nothing essentially antagonistic between those two means of transport. Road transport ought to be so directed as to be a feeder to the railways. He suggested that motor and railway interests should get together and formulate a common policy.

THE Cascade range is crossed by the Great Northern Railway of America at an elevation of 3385ft. above sea level with several sharp curves, severe gradients and numerous tunnels, including one 13,873ft. in length. The existing large number of snow sheds are not sufficient to cope with the snow troubles and more are necessary. Their provision and the cost of the maintenance of the existing and of the new sheds are such that the question of a new route, which would involve a long tunnel, has been under consideration. It has now been decided to provide one which will have a maximum elevation of 2879ft. It, however, involves a tunnel 7·75 miles long, which will be the longest railway tunnel in America.

How Sir Eric Geddes arrived at his estimated savings through the grouping of the railways, of twenty-five millions a year, may some day be publicly revealed. There was a possibility of the facts being disclosed when the objections of the London County Council before the Railway Rates Tribunal were presented on the 14th instant, but Mr. Huscomb, of the Statistical Section of the Ministry of Transport, produced an affidavit by Mr. J. R. Brooke, the Permanent Secretary to the Ministry, that, in his opinion, the production of the figures would be prejudicial to the interests of the public service. We would add that, as related in this column of our issue of October 16th last, the railway companies disavow all responsibility for the figures.

IT is officially announced that Mr. James A. Parker, the engineer for the Great North of Scotland Area of the London and North-Eastern Railway, retires on the 31st instant, on which date Mr. W. A. Fraser, the engineer for the Scottish Southern Area, will become the company's engineer for Scotland. Mr. R. Peters, of Darlington, will be stationed at Aberdeen as resident engineer. Mr. Parker, who, before he went to the Great North of Scotland in 1907 was new works engineer on the South-Eastern and Chatham, also held the independent position of engineer to Aberdeen Joint Station, the property of the Caledonian and Great North companies. He was responsible for the building of the new station there, which, from an architectural, engineering and railway operating point of view, is one of the finest stations in this country.

ANOTHER level crossing disaster occurred on the 12th instant near Forest Hall Station on the Newcastle-Berwick main line of the London and North-Eastern Railway. A fog prevailed and the occupants of a motor car neither saw nor heard an approaching express. The latter struck the car and two of the three occupants were killed. Judging by the illustrations of the scene of the accident that have appeared in the Press, it is an occupation crossing and therefore, as related on page 697 of our issue of December 19th, 1924, the railway company has no responsibility for its use. In the present case it was stated that a youth opened the gates. Presumably he happened to be near them when the car arrived and opened the gates as a favour. Should, however, the youth have been in the railway company's employ an interesting situation would arise, as undoubtedly his action could be regarded as an invitation to cross.

Notes and Memoranda.

A REPORT recently issued by the Diesel Engine Users' Association gives the working costs of heavy oil engines for the year 1924–25. The average total engine cost of the thirty-six home stations with a total output of over 32,000,000 units was ·806d. per unit generated, and for the eight overseas stations, with a total output of over 18,000,000 units, ·746d. per unit generated.

ACCORDING to a recent German invention tar containing water is treated with a sufficient quantity of a neutral salt, such as magnesium chloride, magnesium nitrate, ammonium nitrate, excluding calcium chloride, to form a moderately concentrated solution with the water present. The whole is stirred mechanically at about 70 deg. Cent., and when agitation is stopped rapid separation into a top layer of tar and a lower layer of salt solution follows.

PERCENTAGES of lump coal obtained in a typical Western Pennsylvania coal mine by investigators of the U.S. Bureau of Mines and Carnegie Institute of Technology were increased from 56·5 to 65 per cent. in wide face workings. This was accomplished by varying explosives, width and direction, hole placement, coal snubbing and the use of rock dust for stemming in holes. The results of these tests, which have enabled mine owners to increase their production percentages, are contained in Bulletin 19, "Coal Mining Investigations," issued by the Carnegie Institute of Technology, Pittsburgh.

WHAT is claimed to be the largest frequency changer ever built is approaching completion at the works of the Westinghouse Electric and Manufacturing Company, at East Pittsburg, Pa., U.S.A. It has an output of 40,000 kilovolt-ampères at 300 revolutions per minute. The design of the 60-cycle end of the machine incorporates an arrangement by which the stator may be shifted by means of a motor-driven rotating gear. This provision is for the purpose of adjustment of phase position, and thereby load adjustment. The machine is cooled by a closed ventilating system which includes air-washers.

THE Trumbull Steel Company of Warren, Ohio, uses a lifting magnet for recovering valuable strip steel from pickling tanks. Frequently when the rolls of steel are lowered into the acid tanks the cradle accidentally slips or tilts, leaving some of the steel strip on the floor of the tank. To drain the tank would be costly in the waste of materials and time, and previous methods of grappling injured the metal. An Ohio Electric and Controller Company lifting magnet, provided with a special A-frame for supporting the lead-covered terminal leads of the magnet, solved the problem satisfactorily. Numerous methods employing lifting magnets for handling metal under corrosive baths have recently been applied with great economy.

THE last word in her fittings for deep sea fishing, the Neptunia, the second largest French steel trawler, was launched from the Ouse shipbuilding yard at Selby. She is 175ft. long, 29ft. broad, and has a steaming radius of 6000 miles without re-fuelling. Her bunkers carry 450 tons of coal, equal to twenty-one days' steaming at 12 knots. The vessel's owner, which is a Havre company, is fitting the latest radio apparatus, with a 3000 miles radius, so that she can keep in touch with the firm during her journeys of six weeks to the Grand Banks and White Sea. She has a water ballast tank from midship to forepeak, so that the captain can trim the ship at sea. The vessel will carry a crew of forty, who will salt the catches, and is the first extra large trawler to fish from the port of Havre.

OPERATIONS of Radium and Rare Earths Treatment Company, N.L., at Radium Hill, South Australia, during the twelve months ended October 31st last, were chiefly confined to development work. The directors report that large bodies of good ore have been developed, and important lode discoveries made in the vicinity of the main workings. At Dry Creek, five miles from Adelaide, 18 acres of freehold land were purchased, and thereon has been erected a building in which is installed machinery and chemical appliances for the treatment of radio-active ores. Attention is also being given to extending this plant for the treatment of ilmenite ores. The directors state that many inquiries locally and from abroad have been made for the concentrates. The bulk will be treated at Dry Creek and the surplus sold.

THERE are estimated to be 91,377 motors installed in the central generating plants and in the sub-stations of the United States, with a total rating of 1,275,566 horse-power. Of this number, 19·5 per cent. are of more than 5 horse-power and 80·5 per cent. are rated at 5 horse-power or under. Approximately 91·9 per cent. of the total rating is in motors over 5 horse-power and 8·1 per cent. in motors of 5 horse-power and under. These figures include motors used to operate oil switches both in the generating plants and in the sub-stations. No relation can therefore be drawn between the number of generating plants and the number of motors used. The iron and steel, food, machinery and textile industries are the only primary industries which lead the central stations in the rating of motors run by energy generated in central station plants. In number of motors the central station is led by the iron and steel, food, textiles and the paper and printing industries.

DURING the course of a lecture on Joule's life and work in Salford, delivered before the Salford Education Committee, Professor W. H. Haldane Gee said that Joule published about 120 papers, many revealing extraordinary patience and thoroughness, recording thousands of measurements. The most enduring memorial of him was the adoption of his name for the unit of work—the Joule. There was a fine memorial of him in the Manchester Town Hall. Was there any of him, he asked, in Salford? In Manchester there was a John Dalton-street. Why not a Joule-street in Salford, or, better still, a Joule Scholarship at the Royal Technical College? All his labours were done within a radius of 6 miles of that building. It would be a happy idea if some wealthy brewer, for example, would help in this. He was sure the College authorities would welcome a memorial there and that the Art Gallery, too, would be glad of a portrait of this eminent local scientist.

Miscellanea.

IT is proposed to make a levy of 3 per cent. on the royalties on timber in British Colombia with the object of providing funds for forest preservation.

As from February 1st next the duty on coal imported into Switzerland is to be reduced from the present rate of 2f. (1s. 7d.) to 1·50f. (say, 1s. 2¼d.) per metric ton. Further reductions will probably be made during the current year.

A LARGE deposit of diatomite or infusorial earth has been discovered in Stisbed township, Muskoka district, Ontario. The deposit, which ranges from 5ft. to 25ft. in depth, extends over an area of about 30 acres, indicating a quantity of about 250,000 tons.

THE Department of Marine at Ottawa has authorised a wave length of 52·51 m. as the "Trans-Canada" wave length exclusively for long-distance relay work. This is also the authorised wave length for communication with other parts of the Empire.

CONCURRENTLY with the restarting of many collieries in Northumberland and Durham the demand for coal—both steam and gas—is expanding substantially, and the prospects of the trade for the first quarter of the year are exceptionally good. Prices, despite the increasing output, are rising.

THE 861-mile telephone cable between New York and Chicago, said to be the longest telephone cable in the world, has now been completed. The cost of the work has been about 25,000,000 dollars. It is stated that 500 telegraph and 250 telephone messages can be transmitted over the cable simultaneously.

BRITISH wireless apparatus is steadily entering into general use in Spain, particularly in the Vigo district. There is a heavy Customs tariff, but it has not deterred traders. French and German firms have secured a large amount of business, and American and Italian manufacturers are competing in the market.

THE floods in Belgium are interfering with the working of several pits in the valleys of the Sambre and the Meuse, and the coal output for January will therefore be considerably reduced. One of the Marihaye concern's pits was saved just in time from being drowned altogether by the water finding its way down one of the shafts.

DURING the year ended October 31st, Canada exported to fifty-three countries 52,903 motor cars valued at 25,168,869 dollars, trucks to the value of 5,016,000 dollars, and also parts worth 5,573,875 dollars. Automobile exports during the corresponding period of 1923–24 numbered 45,194, of the value of 23,109,331 dollars.

LEGISLATION has been promoted in the United States for the appropriation of 82,000,000 dollars for the completion, within five years, of six inland waterway projects on the Ohio, Illinois, Mississippi and Missouri rivers. The schemes assume the withdrawal from Lake Michigan of 10,000 cubic feet of water per second—a flow nearly equal to that of the river Thames during the height of the recent flood.

THE board of Cyprus Asbestos Company reports that the extensions to the plant in Cyprus were completed in October, and the new plant has run most satisfactorily under actual working conditions. The production figures to date give a combined total of 8000 tons of fibre per annum. The board has decided to carry out further additions to plant, so as to raise production during 1926 to at least 12,000 tons.

THE Colonia, the largest cable steamer in the world, has sailed from the Thames to lay a duplicate cable over the 1800 miles between Cocos (Keeling Islands), in the Indian Ocean, and Fremantle, Australia. The cable to be laid is of the new loaded type. It is the first British owned and manufactured loaded cable to be put down. The cable is the property of the Eastern Extension, Australasia and China Telegraph Company, one of the Eastern Associated Telegraph group. It will have a working capacity of 2100 letters a minute.

A CONSIDERABLE amount of money has been spent in recent telephone developments in and around Shrewsbury, and more is in contemplation. The new automatic exchange which has just been brought into use has cost £27,000, a sum of £20,000 has been spent in laying 15 miles of underground wires in the town, and £73,000 has been the cost of laying an underground trunk cable connecting Shrewsbury with Wolverhampton. The Post Office also have a scheme for connecting Shrewsbury with Chester and Liverpool by means of an underground cable, which, it is hoped, will be completed in a year or two.

AT a recent informal meeting of the Institution of Electrical Engineers Mr. C. L. Lipman opened a discussion upon "The Design and Performance of Protective Relays." He showed a large number of lantern slides illustrating the operation and range of relays for all duties, and several types of the instruments described were on exhibition. Dr. R. D. Gifford said one of the great difficulties of the designer arose from the tendency of voltages to increase, and, with the consequent fall in current, transformers were almost at their winding limits. Colonel K. Edgcumbe said that in the United States, where until quite recently it was the practice to scoff at relays, they were now very much used, and the larger supply authorities employed a "relay engineer," whose duty it was to inspect and maintain the automatic protective devices.

A DISASTROUS fly-wheel burst occurred in the Stalybridge district recently, causing considerable damage to the engine and surroundings. The wheel was a built-up one, 15ft. in diameter, having eight arms and eight weight segments. The rim joints were secured to the arm ends by four 1⅛in. bolts, and the butt joints of the segments were each made by means of a wrought iron dowel, through which cotters were passed. The disaster occurred within a few seconds of starting the engine after a week-end stoppage, and before it had reached its normal running speed of 93 revolutions per minute. Three of the segments of the wheel were flung bodily out of the rim. One was projected upwards through two floors of the mill, where it came to rest, while a second was flung horizontally through the end wall of the building—24in. thick—into an adjacent canal.

MULTIPLE BAR-SHEARING MACHINE

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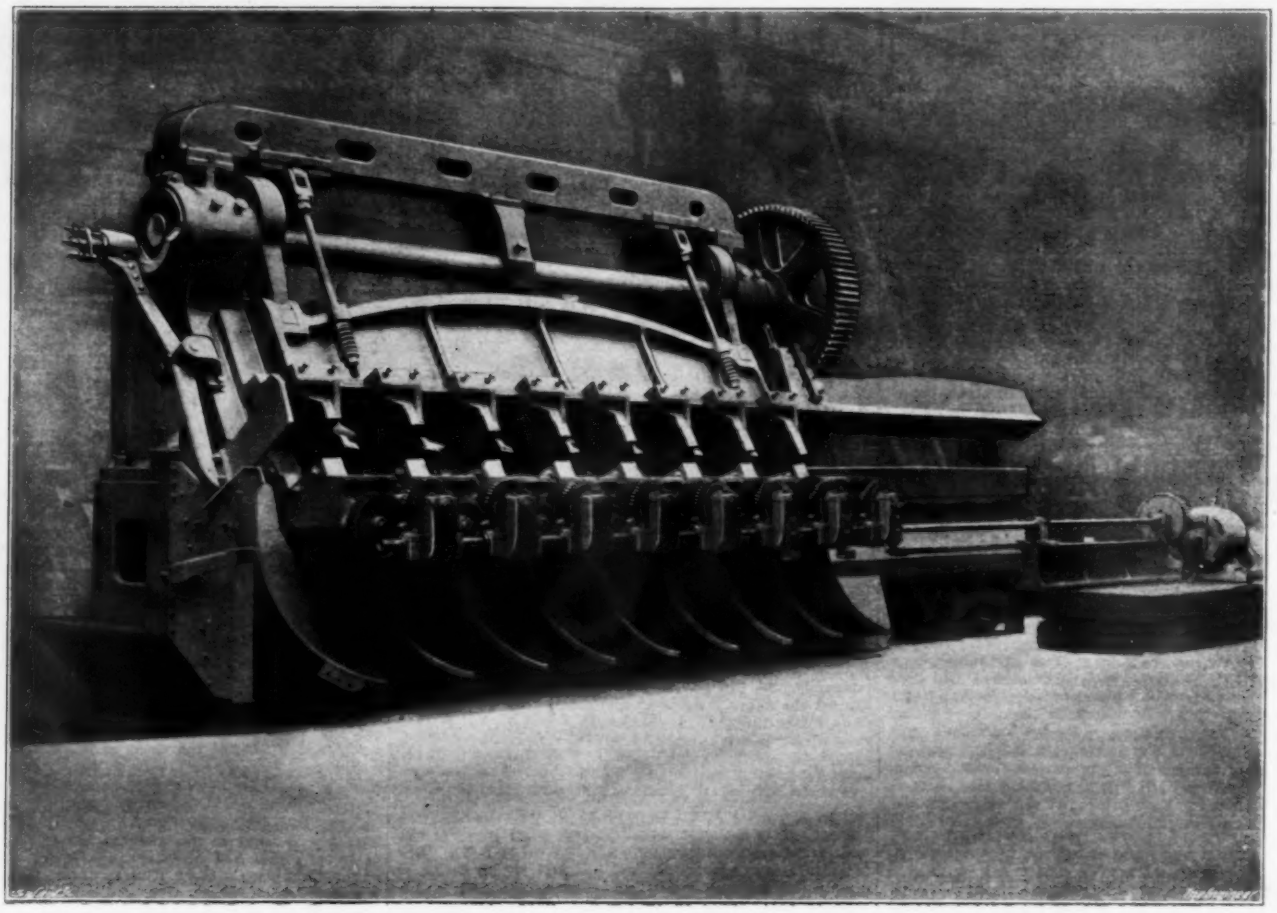
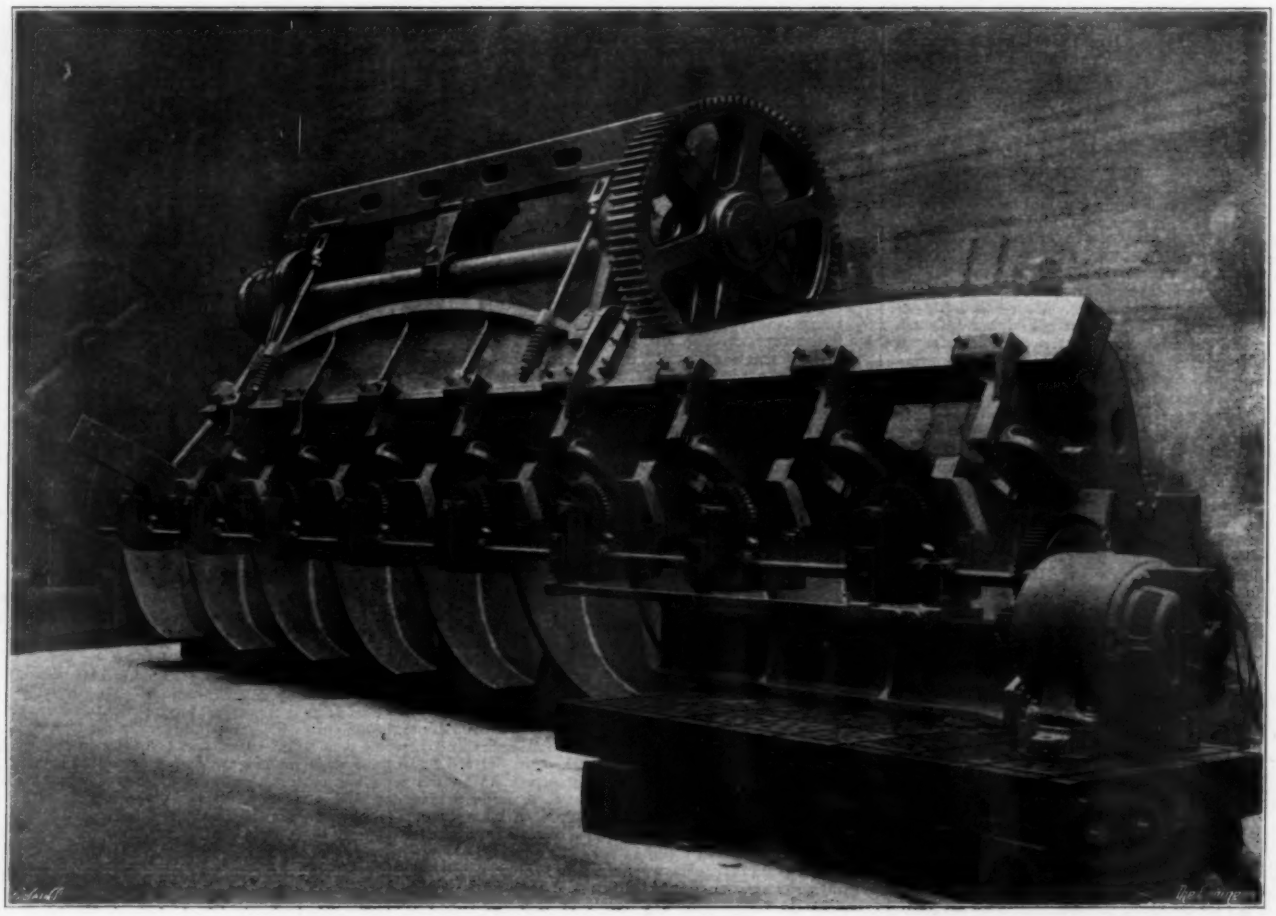
(*For description see page 105*)





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Contents.

THE ENGINEER, January 22nd, 1926.

	PAGE
A SEVEN-DAY JOURNAL	87
AN ELECTRICAL METHOD FOR MEASURING SMALL FLUID PRESSURES. (Illus.)	88
WHIRLING SPEEDS OF DRUM ROTORS. (Illus.)	89
LINOLEUM MACHINERY. No. I. (Illus.)	90
LLOYD'S REGISTER: ANNUAL SUMMARY	92
AUTOMATIC TRAIN CONTROL IN AMERICA. (Illus.)	93
WAIROA RIVER REINFORCED CONCRETE BRIDGE. (Illus.)	94
THE DESIGN OF PITOT-STATIC TUBES	94
LETTERS TO THE EDITOR—	
Waterloo Bridge—The Future of the Economiser—Torsion Meters—The Steam Locomotive	95
IRON AND STEEL PRODUCTION IN 1925	95
NEW LOCOMOTIVES FOR THE NORFOLK AND WESTERN RAILWAY. (Illus.)	96
WATER POWER IN ITALY: THE ORBA TORRENT	98
SIXTY YEARS AGO	98
RAILWAY MATTERS—NOTES AND MEMORANDA—MISCELLANEA	99
LEADING ARTICLES—	
Electricity Supply	101
Furnaces and Combustion	102
LITERATURE	102
MULTIPLE BAR-SHEARING MACHINE. (Illus.)	105
IMPROVED STEAM TURBINES. (Illus.)	105
BOOKS OF REFERENCE	107
A BRITISH CIMENT FONDU FACTORY	107
TWO-STROKE CRUDE OIL ENGINE. (Illus.)	108
PROVINCIAL LETTERS—	
The Midlands and Staffordshire—Lancashire	109
Sheffield—North of England	110
Scotland—Wales and Adjoining Counties	111
CONTRACTS	111
CATALOGUES	111
CURRENT PRICES FOR METALS AND FUELS	112
FRENCH ENGINEERING NOTES	113
BRITISH PATENT SPECIFICATIONS. (Illus.)	113
FORTHCOMING ENGAGEMENTS	114
PERSONAL AND BUSINESS ANNOUNCEMENTS	114

TWO-PAGE SUPPLEMENT—NORFOLK AND WESTERN RAILWAY, 4000 H.P. TWO-UNIT ELECTRIC LOCOMOTIVE; AND INDEX TO VOL. CXL.

THE ENGINEER.

JANUARY 22, 1926.

Electricity Supply.

THE cheap and abundant supply of electricity which the people of this country have long been promised has once again been brought to general notice by the Prime Minister's recent speech at Birmingham. From a technical point of view the speech was not of very great interest, for all the proposals made are now quite familiar to engineers. As electricity cannot be stored in large quantities, like gas or water, the interconnection of large and modern power stations is considered to be the most satisfactory method of insuring supplies in emergency, improving the load factor and providing consumers with current at the lowest rates. After careful consideration it has been decided that, notwithstanding the outlay involved in standardising frequency—which is necessary for linking up—and the cost of transmitting the current, it will pay to embark upon an extensive scheme of interconnection, which, incidentally, will serve to meet the demands of those who at present are outside the existing supply areas. One of the reasons why electricity is used more extensively in other countries than in England is that abroad transmission lines often penetrate into many rural and other districts. Water power in other countries has automatically placed electricity at the disposal of farmers and others, who in other circumstances might still be without supplies. In the United Kingdom Providence withheld water power on the large scale when it gave abundance of coal. Coal being utilisable locally, the necessity which drove other countries to provide electricity supplies over long distances did not exist, and to this day electricity for power is neither abundant nor cheap. By linking up stations it is hoped to kill several birds with one stone, to improve the load factor, reduce the number of stations and amount of spare plant, and to place current at the disposal of people who in the past have been compelled to use other forms of power or to do without mechanical power at all. Before the scheme can be put into operation the present difficulties in the way of erecting transmission lines will, of course, have to be removed; but with this matter Mr. Baldwin did not deal, nor did he indicate what sort of revenue the electricity supply authorities are likely to derive from the rural areas. The scheme, as we understand it, has been designed partly with a view to meeting the farmers' demands, but those demands are not very attractive. In fact, it is stated in the report of the Electricity in Agriculture Committee, published in the *Journal* of the Institution of Electrical Engineers for August, 1925, that in some parts of the Continent such supplies are unremunerative. It is probable that the most efficient way of supplying rural districts will not exist until long-distance railways are electrified. If that were done farmers and others in out-of-the-way places could be supplied with current without much trouble or expense from the railway mains; but electrical engineers have not yet convinced the railway companies that main line electrification pays. Hence that means of distribution is not now available nor likely to be available for many years to come. In the meantime a national system of interconnection involving the erection of special lines is to be established.

We are glad to find, however, that it is recognised that something more is needed than the mere linking up of power stations and the standardisation of frequency. As a matter of fact, in some countries—the United States, for instance—where the number of units sold per annum per head of population is high, frequency has not been standardised at all. Engineers who have visited places abroad with a view to studying electricity supply conditions have expressed different views concerning the reason for the backward state of England. On returning from America, where incidentally in these days the people have more to spend than those in this country, Mr. Patchell expressed the opinion that the success of the American electricity supply undertakings was due in a large measure to efficient salesmanship. Lack of good business management has no doubt been largely responsible in the past for the slow progress in many parts of England. Engineers with no commercial training or inclinations have been entrusted with the complete control of electricity supply concerns, with the result that there has been little, if any, attempt to increase the business, and the cost of current has remained high. Yet some stations, and not always those of exceptionally large size, have been run with marked success. If the new scheme includes the introduction of a good business element, as apparently it does, on the distribution side, then an increase in the demand may be looked for, quite apart from any question of linking up or the standardisation of frequency. Many of the supply undertakings have never made a real effort to improve their load factors, or indeed to do anything beyond supply the consumers they happen to possess. But whilst cheap current might go a long way towards increasing the demand, it would not remove all the difficulties. The cost of wiring houses and of installing apparatus would still have to be faced. Not many weeks ago a well-known professor described in a paper read before the Institution of Electrical Engineers an "all-electric" house supplied with current at remarkably low rates, but he was careful to avoid giving the cost of the installation. Not a few people in this country, we imagine, would be unable to use electricity if it were supplied to them free, for the simple reason that they could not afford to install the apparatus for consuming it.

We must confess to some doubt that the national interconnection which may be regarded as the keynote of the scheme will have the expected effect on the load factor. The proposal, said Mr. Chattock in his presidential address before the Institution of Electrical Engineers, had been tried to a certain extent in America, and experience had shown that the peak load rose as fast or even faster than the output. The expansion of these large systems by means of heavy trunk lines running long distances has not had the effect of improving the load factor on the system, but, on the contrary, tends to decrease it, as the area of supply grows larger. Whilst most engineers agree that linking up is quite justifiable and desirable within limits, it is not certain that a national scheme of interconnection is necessary from the point of view of economy. Similarly, whilst it is generally recognised that there are still many small and uneconomical stations in this country that ought to be abolished, it remains to be proved that the large stations can supply all parts of the United Kingdom as cheaply as relatively small stations designed on modern lines and erected where the current is actually required. There is a tendency, we fear, to compare new super power stations with small stations that were built many years ago and which are naturally very inefficient. If a new super-power station and its network were compared with small plants of the most efficient type it is quite conceivable that, in some cases at any rate, the former would have little to recommend it. Someone has apparently told Mr. Baldwin that stations working at different frequencies cannot be interconnected. A standard frequency would greatly facilitate interconnection, but a considerable number of stations are already connected together through frequency changers. By constructing very large machines of this kind the American manufacturers have been able to raise the efficiency and considerably to reduce the cost per kilowatt. We are, however, very much alive to the advantages of a standard frequency, our only difficulty

being to see how it can be brought about without great expense and inconvenience. Professor Forbes has argued that by employing frequency changers the standardisation of frequency could be avoided and that the cost of this item would be reduced from millions to thousands of pounds; but he ignores the fact that there would be a constant loss, which in the course of a year would represent a very large sum of money. It is said in a recent issue of *The Times* that standardisation will be effected at an estimated cost of ten millions—a figure which seems to us to be a good deal on the low side. From the same source we learn that the complete scheme will take about fifteen years to materialise, which, in our opinion, is also a somewhat optimistic estimate. Incidentally, in the meantime new developments may completely alter the whole situation.

With the administrative side of the scheme we are not very much concerned. Details of the proposals have already been published in the daily newspapers. Briefly, it is intended, in addition to strengthening the powers of the Minister of Transport and the Electricity Commissioners, to set up an executive board with powers covering the whole country for the purpose of establishing interconnecting lines and co-ordinating in large areas both the existing large modern stations and others which will be required. This new body, we are pleased to note, will raise its own capital and work on ordinary commercial lines, and when it has earned interest and sinking fund on its capital any surplus will be devoted to the reduction of charges for current. No Government subsidy will, we are assured, be required, but to enable the venture to be carried out successfully and to see it through its early years, it will be necessary to extend to it a Government guarantee similar to that which has been given under the Trade Facilities Act to many fruitful enterprises. The larger stations will apparently continue to be operated by their present owners or by companies or municipalities, which may build others in the future, but they will work together under the Board for the production of a common supply of electricity, which the Board will purchase and make available to all its distributors. Everyone will be compelled to adopt the standard frequency, for it has been decided, in spite of the recommendations set forth in the Coal Conservation Committee's report of 1918, that it is impossible to supply current economically unless standardisation is brought about. It will be part of the Board's duty to effect at its own cost standardisation in all areas as they are connected.

Until the Bill is introduced details of the scheme cannot be discussed. For the present we will merely say that we are unable to share the enthusiasm displayed by certain prominent electrical engineers and Labour leaders. The electrical manufacturers owe a deep debt of gratitude to the Government for introducing the measure, for, assuming that the Bill is passed, it will bring them a great deal of profitable work. The Labour leaders rejoice in it because they see in it a first step towards the nationalisation of a great industry. The position of the public is another matter. That it will be provided with cheap current at an early date, as it is being led to suppose, is less than problematical. There is little or no likelihood that a scheme so vast can approach completion in less than fifteen to twenty years, and it is impossible to foresee what may have taken place in that time. Fortunately, it is one of those schemes which can proceed step by step, and whilst the country may commit itself to the general principles laid down it will not be called upon to find a very great sum of money or to make any great alterations in present systems *per saltum*. In many respects it appears to be a revival of the grandiose super power station scheme which attracted no little attention and aroused the enthusiasm of the uncautious some years ago, but had apparently been allowed quietly to fade away as recognition of its demerits were brought into proper relationship with its merits. That cheaper, much cheaper, electricity would be of benefit to the industries of the country and would be welcomed by the householder is beyond all question. It may be admitted, too, that the present scheme would result in a decrease of costs; but it is still uncertain that, when the cost of transmission is considered, it presents the very best and quickest method of ensuring abundant and cheap electricity to all parts of the country.

Furnaces and Combustion.

COMBUSTION, like all other changes, takes time for its completion. From the slow rusting away of iron to the practically instantaneous detonation of an explosive, we have a range of phenomena all possessing the characteristics of combustion, yet differing enormously in the time required for the combination of oxygen with its particular fuel to take place. The kind of combustion which particularly interests the steam engineer is that of coal. He has to provide the necessary facilities for bringing the coal and oxygen together in proper proportions, and the faster the chemical reactions can be carried out, so long as they behave themselves quietly, the greater is the commercial efficiency of the process. A slow rate of burning necessarily means large furnaces. These are not only more costly in themselves and in the housing they require, but they are, in general, more expensive to maintain than those of smaller dimensions. Now that single boiler units are being constructed with an evaporative capacity enormously greater than that of only a few years ago, the size of furnaces is becoming an important consideration. A large modern boiler may consume as much as 10 or 12 tons of coal per hour, and since the faster a ton can be made to disappear, the smaller will be the grate area and the less the furnace volume required, the highest practicable rate of combustion is obviously to be desired. It is only during the last few years that much attention has been paid to the relationship between furnace volume and boiler capacity, and as every engineer knows, there is no general agreement on the subject. In current practice, with mechanical stokers, the furnace volume usually lies between 250 and 450 cubic feet for every 1000 square feet of boiler heating surface, though important installations are to be found even outside these limits. The tendency seems to be to increase furnace volumes, rather than to diminish them, and modern ideas would hardly sanction less than 350 cubic feet per 1000 square feet of heating surface. At Hell Gate power station, with Taylor stokers, there are 8000 cubic feet of furnace volume to 15,900 square feet of heating surface. For burning coal in a pulverised form the furnaces are much larger, and here, again, the tendency appears to be towards even greater size. At one of the American powdered fuel stations there are boilers with over 800 cubic feet of furnace volume per 1000 square feet of surface. Mr. Patchell, at a meeting of the Institution of Mechanical Engineers last year, said that to stand in one of these furnaces was "like being in a cathedral." Now, cathedral-like structures, even if they are not disproportionate in size to the boilers above them, are very expensive, and the larger the boiler the more important it becomes to keep down the relative size of the furnace, if this can be done without sacrifice of efficiency.

The whole question of furnace sizes seems to turn on the point of how many heat units can be liberated per cubic foot of volume in a given time. Since the heat units are only generated, directly or indirectly, at the surface of the coal, it would appear that the burning surface may be as great as possible for a given quantity of coal. In other words, the finer the coal the faster it could be burnt. This argument would lead to the conclusion that pulverised coal should require less furnace volume for a given heat output than coal burnt in solid form. Such, however, is not the case. A powdered fuel furnace is nearing the limit of its efficient performance when producing 20,000 B.Th.U. per cubic foot of its volume. Three times as much heat can be developed per cubic foot of stoker-fired furnaces, and even these are surpassed by hand-fired locomotive or Scotch marine boilers. It is evident, then, that some factor has been left out of consideration. Fuel surface alone is not the only requisite to rapid combustion; an adequate supply of air to the burning surfaces is the other requisite. The quantity of fuel burnt per hour in a given space would seem to have no limit if oxygen could be brought up to the burning surface rapidly enough. In gunpowder, where the oxygen is actually present in sufficient quantity, the carbon is burnt almost instantaneously, and no volume greater than that of the charge itself is necessary for complete combustion. The only way we can hasten the combustion taking place on a given surface of coal is by increasing the draught so that the supply of oxygen is renewed with greater rapidity. If, in the desire to have the maximum burning surface we reduce the coal to such a fineness that it will not stay still against the draught we defeat our ends. This is one of the reasons why pulverised coal burns so slowly per cubic foot of furnace volume. The individual particles are protected against burning by their very lightness. Each becomes surrounded by its own little atmosphere of carbon dioxide, and however violent the turbulence in the furnace, the particle travels about for an appreciable time, much as a balloon in a hurricane, moving with the gases and therefore unaffected by their velocity. It would be destroyed in an instant if it could be kept still, so that its protecting atmosphere could be swept away and replaced by more oxygen. In this connection reference may be made to a plan put forward by a French engineer, M. Jules Deschamps, and described in our issue of February 6th, 1925. By employing pulsations in the supply of air to furnaces, M. Deschamps has succeeded in meeting the retarding influences to which we have referred, and greatly accelerating combustion. There is also the practical difficulty, when using a heavy draught to get the necessary amount of air through a burning coal bed, that the lighter particles are blown away altogether before they are consumed. Everyone who has tried to burn coke breeze with forced draught knows how much of the fuel is carried away unburnt, and lodges in the economisers or distributes itself over the neighbouring landscape by way of the chimney. It is quite a tenable proposition that, from the point of view of developing the maximum of heat in a given space, the principle of burning fuel in a pulverised form is unsound, for the reasons we have indicated. Pulverised coal systems have other advantages, such as ease of control and high efficiency of combustion, but those are matters with which we are not at the moment concerned. Yet it is interesting to reflect upon the fact that the same ends may be reached by the diametrically opposite path. It is possible to imagine extremely high rates of combustion brought about by air jets playing on the incandescent surface of the layers of briquetted fuel, suitable provision being made for the elimination of ash and slag as fast as they are produced. Experiments on these lines, especially if comprising the principle of using the radiant heat from the fuel bed to the utmost, might have a marked influence on boiler design. The system of burning coal in a pulverised form has been tried on a sufficient scale to make evident both its merits and its defects, and an experimental move in the opposite direction would at least be instructive.

The most efficient use of furnace volume is probably made when oil is burnt with mechanical atomising. Under such conditions, it is easily possible to liberate 100,000 B.Th.U. per hour per cubic foot of furnace volume, and figures more than half as great again have been recorded. This, it may be said, is the very antithesis of solid fuel burning, and is the limit to which pulverisation is tending. Any analogy, however, between pulverised coal and atomised oil is an unsound one. The finest possible particle of pulverised coal consists of an incredible number of molecules, which are only separated from it one by one as oxygen comes within their radius of action. The particle is still a solid, even if, according to our ordinary standards of comparison, it is a small one. A particle of oil, on the other hand, is a liquid, and at furnace temperature it becomes gasified, each molecule taking its own path at a high velocity amongst the other molecules of the furnace gases. It has thus an excellent chance of rapid combination with any unattached oxygen. The central molecules in the coal particle, moreover, have to wait their turn for combination until all the exterior particles have been carried away, whereas the evaporation of the oil particle allows all its molecules to have their chances simultaneously. The solution of the problem of burning coal lies in the direction of keeping the air supply in continuous and violent attack on the carbon. That is achieved by employing very large furnace volume with powdered fuel, but it is worth considering if the rate of combustion of solid fuel could not be increased in furnaces of relatively smaller size.

Literature.

Oilfield Exploration and Development. By A. BEEBY THOMPSON, O.B.E., M.I. Mech. E., M. Inst. M.M., &c. In two volumes: (1) Oilfield Principles; (2) Oilfield Practice. London: Crosby Lockwood and Son. 1925. Pp. 1177 + xxiv. and Index. Price £6 6s.

WITH the exception of Redwood's treatise on petroleum, published in 1896, and later revised in 1906 and 1913, there has not appeared a comprehensive British work of the magnitude and scope of the present volumes until now, though characteristically American literature has from time to time been weighted by what one may term "super" technical productions. Probably the majority of oil technologists are temperamentally unable to settle down to the colossal task of writing a complete survey of the industry, even though they possess the requisite

diversified knowledge; at all events, Mr. Beeby Thompson has put forward what on contemplation alone is nothing short of a herculean literary effort, and if for that and no other reason, his name will be remembered by a grateful petroleum posterity.

Viewed from another angle, however, there is legitimate doubt as to the wisdom of compiling these great texts nowadays. In no other industry at the moment are component operations so strikingly differentiated and ramified as in the oil industry; every phase of it is a specialised technical study; every element of its complex machinery the concern of specially trained individuals. The public, of course, grasps essential, correlated results, and for it a comprehensive literature, void of detail, may suffice; but those within the industry, whether engineer, chemist, geologist, administrator, merchant or economist, must inevitably learn their operating codes from books written specially for them by men who are experts in their own particular lines, quite apart from their essential practical training, and for them no broad compilation or treatise can now be entirely adequate. This is simply the outcome of the manner of evolution of the petroleum industry from Redwood's time until to-day. Then the force of research and intensive study had still to be felt; now, by an almost amazing rapidity of progress, an ever-widening perspective, not only of the industry as a whole, but of its constituent branches, compels concentration and mastery of a part—the essence of modern scientific training.

It would be impossible to do justice to every aspect of the petroleum industry in a work twice the size of this. The author himself perhaps recognised that limitation when he wrote in a praiseworthy Preface: "At times one felt how inadequate must be any one book dealing with so vast a subject." It is, however, because the author has the gift of writing rather than the knack of compiling that many of the shortcomings of this work may be forgiven. Parts of it, especially in Vol. I., are so infused with happy personal observations made over a long association with the industry in all countries of the world, that what would otherwise be prosaic or stereotyped becomes animated and instructive.

From the reviewer's standpoint, works of this size and scope inherently offer a wide field of possible criticism. It is so easy to say—with the critics of the usual anthologies, for example—"he might have put this in" or "this should have been left out," or "this should have been elaborated," and so on. A score of instances occur to the mind in the present book. But the better purpose is served by deprecating the principle of publication of large expensive works of wide purview, whose price necessarily puts them beyond the reach of many to whom they should make the strongest appeal, but whose admitted generalisation must limit their utility from a purely technical standpoint. Bearing this in mind, the ground is cleared for a survey of the author's achievement.

The main theme of Mr. Beeby Thompson's original volume was that of the scientific development of oilfields. The revision of that book, rendered necessary by the exhaustion of the edition in 1922, automatically expanded the subject matter into a text nearly twice the size of the first, and one which lent itself easily to division into two main sections—oilfield principles and oilfield practice, Vols. I. and II. respectively. In the first volume the author deals with the theoretical aspects of his science, and discusses chiefly the distribution and geology of petroleum. In the second volume, one which will probably make the greatest appeal to readers of this journal, he treats of petroleum engineering, *i.e.*, oil production, including cable, rotary and diamond drilling, subsidiary operations such as fishing and the control of oil wells, casing and the use of suitable sand screens and strainers, oilfield waters and their exclusion by cementation processes, &c., petroleum recovery (the various operations concerned with bringing oil to the surface), power and general equipment. He prefaces this section with an introductory chapter on the commercial aspects of the industry in which he introduces a useful summary of the intricacies of land, lease, royalty and appraisal problems. He concludes with a special chapter on natural gas—now a self-contained industry—and an appendix embodying useful working constants, functions, and the like.

The whole work occupies 1177 pages, with 32 additional pages of index plus xxiv. of description at the beginning of each volume; 42 pages of advertisements (presumably a necessary evil in a work of this size and cost of production) figure conspicuously at the end of both volumes. There are, however, only 277 illustrations—diagrams, figures and plates—a small number in proportion to the bulk of the text; and, being printed on heavy paper, the books are uncomfortably heavy to hold.

From the reader's point of view, Vol. I. is undoubtedly "smoother" than Vol. II., probably because the subject matter lends itself more readily to a facile pen than that of Vol. II. Practice is invariably more difficult to describe on paper than theory, and oilfield practice is certainly no exception, since many of the operations entailed are intricate, detached and impossible to discuss logically, except in minute detail, unless instructor and apprentice are on the rig, handling the tools, or are otherwise taking active part in field performance.

Finally, we commend to the most serious consideration of the reader the following excerpt from this work: "Whatever the origin of petroleum, it is certain that we are dealing with a wasting asset, and that there is no appreciable production and concentration of oil within measurable periods of time. For that reason, all oil technologists should combine in supporting conservation efforts. . . . There are sound reasons for believing that present methods of extraction usually result in the recovery of but a modest proportion of the oil saturating the productive strata. . . ." The problem here implied largely concerns the engineering profession for its solution, but it is gratifying to find that the author boldly states the case. If this book helps, by co-ordinating scattered knowledge, to a more scientific appreciation of the value, not only of petroleum itself, but of the economic production and utilisation of this commodity, then it will not have been written in vain.

Oil and Colour Chemistry Monographs. Edited by R. S. MORRELL. *Cellulose Ester Varnishes.* By F. SPROXTON. *Blacks and Pitches.* By H. M. LANGTON. London: Ernest Benn, Ltd. 1925. Price 15s. per volume.

THE author of the first of these two volumes is to be congratulated upon the excellence of his book, which contains a concise, lucid, and up-to-date exposition of the manufacture, properties, and uses of the cellulose nitrate and the cellulose acetate varnishes. The method of historic treatment employed adds much to the interest of the subject, and to the clarity with which the matter is presented to the reader.

Cellulose nitrate is made by the action of a mixture of nitric and sulphuric acids on cellulose (cotton). The nitrate used for the manufacture of varnish is closely related to the explosive material known as gun-cotton, from which it differs in having a lower content of nitrogen. Cellulose acetate is made by the action of a mixture of acetic acid, acetic anhydride, and a small quantity of sulphuric acid, upon cellulose. The acetate is now used extensively in the manufacture of artificial silk.

The cellulose ester varnishes are made by dissolving either the nitrate or the acetate in an appropriate solvent. Large quantities were manufactured during the Great War for use as "dopes" for aeroplane and airship fabrics, the function of the "dope" being to protect the fabric from the rotting action of light, to render it waterproof, and in the case of aeroplanes to increase the tension of the fabric on the frames. The advent of peace resulted in a great decline in the demand for "dope," and manufacturers were compelled to seek new outlets for their products. Nitrocellulose varnishes are now largely used for the decorative coating of metal and wood articles. These coatings are classified as follows:—

(1) Transparent lacquers, either colourless or coloured.

(2) Enamels, white, black, or coloured, rendered opaque by the addition of a pigment of suitable colour and opacity.

(3) Metal powder coatings containing bronze or aluminium powder.

In the manufacture of these coatings resins are usually added to the ester varnish in order to give body to the solution and promote adhesion of the coating. The author states that the use of nitro-cellulose enamels for covering motor car bodies is competing with the older methods in the United States. Patent leathers, imitation leather, and snakeskin, compressed cork mats and floor coverings and many other useful commodities are made by the aid of cellulose ester varnishes.

The book contains many useful references, is well printed, and is provided with adequate name and subject indexes. The author refers frequently to the British Engineering Standards Association specifications for aircraft materials, and recommends that the specifications should be in the hands of all manufacturers of cellulose ester varnishes.

As recorded in Mr. Langton's preface, this book on "Blacks and Pitches" contains a concise account of our present knowledge of the black pigments and of the various bituminous materials and pitches of commerce. In the first part of the volume are described the methods of manufacture and the uses of black pigments, including graphite, mineral black, the fixed carbon blacks, carbon black, and lampblack. These materials are used in large quantities in the manufacture of paints, printers' inks, vulcanised india-rubber, stove and shoe polishes, &c. Among the "fixed carbon blacks" are classed the vegetable charcoals and the bone blacks, the latter being used extensively in the sugar refining industry as decolourising agents.

The author devotes considerable attention to the pigment known as carbon black, which is made by burning gases containing hydrocarbons in a supply of air that is insufficient for complete combustion. In America carbon black is made in large quantities from the natural gas of the petroleum fields. The pigment finds increasing application in the manufacture of printers' inks, for which purpose lampblack was formerly the most important pigment in common use, and it is said to be the ideal pigment for filling vulcanised rubber.

The section on pitches contains a description of the various bituminous materials, such as are used in road and pavement construction and in the manufacture of waterproofed fabrics, and of certain paints, varnishes, enamels and japans used for the protection of metal surfaces.

Commercial pitches vary greatly in chemical and physical characters and in availability, the quantity production of some kinds of by-product pitch being relatively small and unimportant. The chief varieties are the native asphalts and asphaltites, the petroleum residual pitches, and the coal tar and allied pitches.

The author describes the methods in use for testing pitches and quotes specifications for materials to be used for particular purposes. He also gives some useful data characterising typical pitches from various sources.

In three interesting chapters at the end of the volume an account is given of the principal commercial products of which the pitches are essential constituents. It is rather surprising, however, to find that no mention is made of the use of pitch in the manufacture of patent fuel.

The only general criticism that can fairly be made is that the author has condensed the subject matter to an extreme degree, with the result that there are some paragraphs of which the meaning is not immediately clear. It is felt that this fault is due almost entirely to the author's desire for brevity. The book is well printed in clear type and is remarkably free from printer's errors. It contains separate indexes for names and subjects, and at the end of each chapter a very full list of references is to be found.

SHORT NOTICES.

Transmission Circuits for Telephone Communication. Methods of Analysis and Design. By K. S. Johnson. London: The Library Press, Ltd. Price 21s.—The material which this book contains was prepared originally whilst the author was conducting one of the special courses for the members of the Engineering Department of the Western Electric Company. During successive repetitions of that course new information was accumulated and is presented in this volume, which covers the general theory and principles which are applicable to the development and design of circuits and lines associated with such telephonic instruments as transmitters, receivers and valves. In preparing the book the author has drawn upon the work of his technical colleagues, although a large part of the volume is apparently based on his own experience. Those who are interested in an analytical study of telephone transmission will find the volume useful, but it is not by any means a book that we should recommend to elementary students of telephony.

Electrical Precipitation. By Sir Oliver Lodge. Oxford University Press. Price 2s. 6d.—On October 28th of last year Sir Oliver Lodge delivered a lecture on "Electrical Precipitation" before the Institute of Physics, and in this volume the lecture is now presented. The subject of electrical precipitation divides itself into two parts, natural and artificial, both of which are dealt with. A third part of the volume is devoted to a combination of the two and suggested meteorological possibilities. There is also an appendix on practical notes on commercial precipitation, written by Mr. Lionel Lodge. In common with most of Sir Oliver Lodge's books, the volume makes interesting reading, and will, we feel sure, be appreciated by engineering and scientific people.

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Eclairage Electrique. By P. Maurer. Paris: Gauthier Villars et Cie., 55, Quai des Grands-Augustins.

The "Ice and Cold Storage" Trades Directory, 1926. London: Iliffe and Sons, Ltd., Dorset House, Tudor-street, E.C. 4. Price 10s. 6d. net.

Beiträge zur Geschichte der Technik und Industrie, 1925. by Conrad Matschoss. Berlin: V.D.I., Verlag G.m.b.H., S.W. 19. Price 25 R. mark.

Mass Production Equipment. By P. Gates. London: Crosby Lockwood and Son, 7, Stationers' Hall-court, E.C. 4. Price 7s. 6d. net.

Turbo-blowers and Compressors. By W. J. Kearton. London: Sir Isaac Pitman and Sons, Ltd., 20, Parker-street, Kingsway, W.C. 2. Price 21s. net.

Practical Marine Diesel Engineering. By L. R. Ford. London: The Simmons-Boardman Publishing Co., 34, Victoria-street, S.W. 1. Price 31s. 6d. net.

The Colliery Manager's Pocket Book, 1926. London: The *Colliery Guardian* Company, Ltd., 30 and 31, Furnival-street, E.C. 4. Price 3s., 4s. 6d. and 6s. net.

The Concrete Year Book, 1926. Edited by O. Faber and H. L. Childe. London: Concrete Publications, Ltd., 20, Dartmouth-street S.W. 1. Price 2s. 6d. net.

The "Practical Engineer" Mechanical Pocket Book and Diary, 1926. Edited by E. G. Beck. London: The Oxford University Press, Falcon-square, E.C. 1. Price 2s. 6d. net.

The "Bennis" Standard Evaporation Tables. Compiled and calculated by G. A. Rossetti. London: Edward Bennis and Co., Ltd., 28, Victoria-street, S.W. 1. Price 2s. 6d. net.

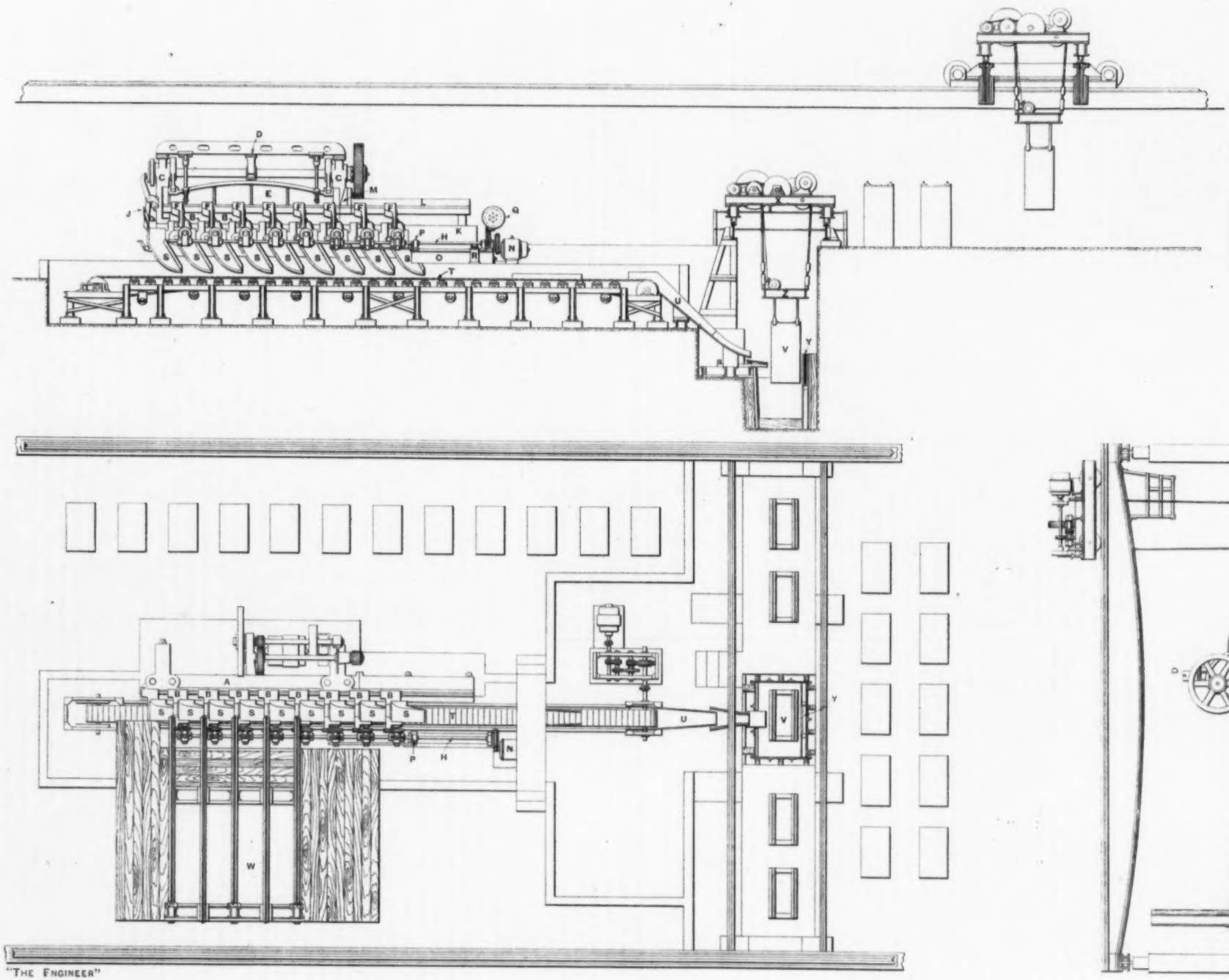
Report on the Conditions and Prospects of British Trade in India. By T. M. Ainscough. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 5s. 6d. net.

Union des Ingénieurs sortis des Ecoles Spéciales de Louvain. 52me Année. 2me Bulletin Technique, Octobre, 1925. Brussels: Etablissements J. Schicks S.A., Rue du Marché du Parc, 28.

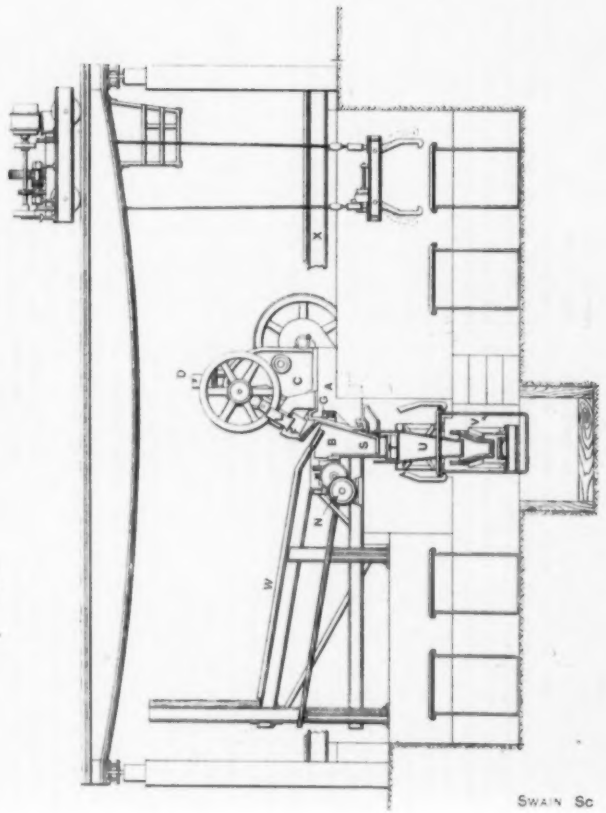
A Survey of the Economic and Commercial Conditions in Morocco, Algeria, Tunisia, and Cyrenaica, 1924–25. London: His Majesty's Stationery Office, Adastral House, Kingsway, W.C. 2. Price 3s. net.

MULTIPLE BAR-SHEARING AND HANDLING EQUIPMENT

(For description see opposite page)



"THE ENGINEER"



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Multiple Bar-Shearing Machine.

ONE of the important operations in the manufacture of sheets and tin-plates is that of cutting up the bars into lengths corresponding to the widths to which the sheets are to be rolled. The method usually adopted necessitates the employment of several single cropping shears, into which the bars are fed by hand, one piece being cut off at each stroke. For the purpose of securing a greatly increased output with the minimum of manual labour for handling the bars, De-Bergue and Co., Ltd., Strangeways Ironworks, Manchester, have designed and constructed a new multiple shearing machine which embraces several original and clever features. Illustrations of the machine are given on page 100, and the general lay-out of the whole plant, including the shearing machine, the conveyor for removing the cut bars, the electric traverser and the grab for handling the bar skips, is clearly shown by the drawing on page 104. The engraving on this page is a separate view of the electric traverser and grab, which have been supplied by Craven Brothers, Ltd., Reddish, near Manchester. The skip-handling grab is the invention of Mr. E. Peter Jones, of the Wolverhampton Corrugated Iron Co., Ltd., to whom also belongs the credit for the general layout of the plant. The drawing also shows the skid in front of the machine for carrying the bars immediately prior to the cutting operation.

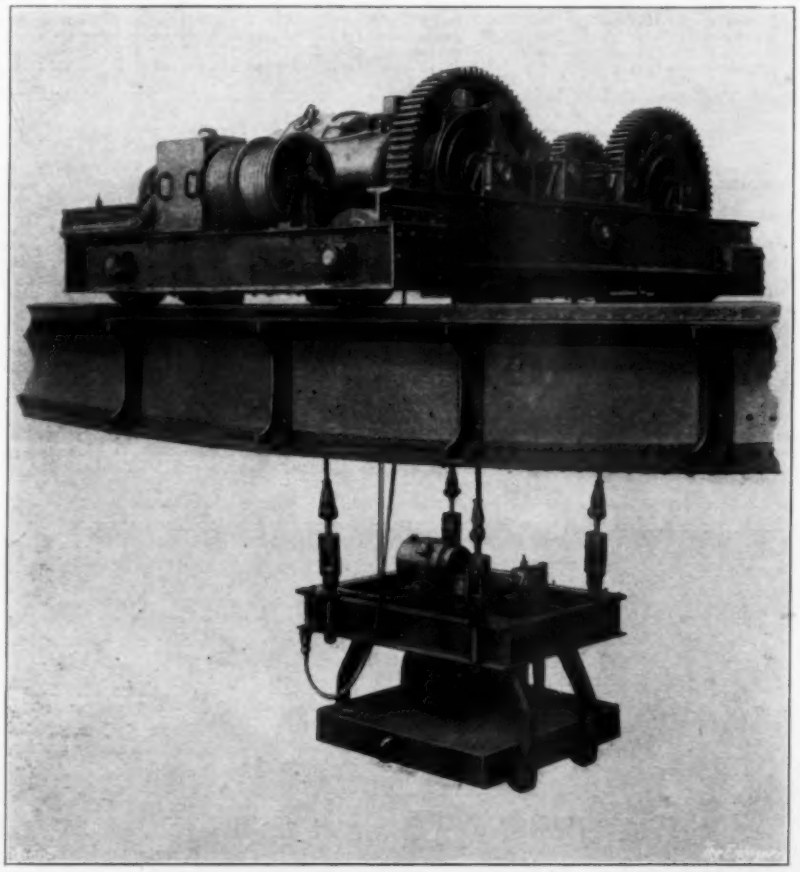
The shearing machine consists of a substantial bed A of box section, provided with planed guides for the reception of the sliding saddles B, which carry the bottom shear blades, and two massive standards C C, secured by means of bolts to the top surface of the bed. These standards are connected at the top by a stay D of box section, and are arranged with planed guides at an angle of 30 deg. with the vertical to take the main shearing slide E, which has planed guides on its underside to take the saddles F carrying the top shear blades. The movement of the shearing slide is controlled by a treadle-operated clutch stop motion. From the half-tone engravings on page 100 it will be seen that there are eight pairs of shear blades. They are adjustable from 23½in. to 41in. apart and the upper and lower saddles are made to engage with each other at the back, so that the lower saddle, when moved along the bed, carries the upper saddle with it. Each lower saddle carries a spur pinion which meshes with a rack G fixed along the main bed. The pinions on all the saddles are driven simultaneously from the shaft H mounted in front of the machine parallel with the front edge of the bed. As the bars to be cut have one end against the stop J at the left-hand end of the machine, it is obvious that if equal spacing of the shear blades is to be maintained the saddles more remote from the stop must travel a greater distance in the same time along the bed than the saddles which are nearer to the stop. This accelerated movement is obtained by the use of gearing of different ratio on the saddles. When the pairs of shear blades are arranged at their wider spacings, some of those furthest from the stop will not be required for cutting. For the support of the saddles carrying these blades there is provided an extension K to the bed, together with a fixed extension L to the main cross slide E at the same level as the slide when in its uppermost position. The saddles which are not required for cutting remain in gear with the rack, which is continued throughout the full length of the bed. In order to avoid any risk of one of the top shear saddles coming partly on the moving slide and partly on the fixed extension, a balanced intermediate slide section M is arranged between the end of the moving slide and the end of the fixed slide extension, this intermediate section having a width slightly greater than that of one of the top shear saddles. At the left-hand end of the machine will be seen the stop J, which determines the length of the last piece of bar to be cut. With the object of taking up any slack and preventing this piece of bar from being cut too short, the end stop is caused to move forward automatically a distance of about 3in. just before the cut takes place.

Adjustment of the spacing of the eight pairs of shear blades is effected by means of the electric motor drive shown at the right-hand side of the machine. This motor drives the shaft H through machine-cut gearing, the wheel of which is fitted with a Ferodo-lined safety slipping device, to prevent any damage to the gearing in the event of the apparatus jamming. The driving power of the slipping gear can be regulated to a nicety, pressure being applied by a number of springs and adjusting screws. The short longitudinal bed O is for the purpose of carrying a sliding bearing P for the support of the longitudinal shaft when the shear blades are spaced at their closer centres. This sliding bearing is drawn into its proper position by a longitudinal bar engaging with a bracket on one of the saddles. The electric motor N is of the series-wound interpolar direct-current type, and it is designed to develop 7 brake horse-power at 670 revolutions per minute, and to be capable of taking a momentary overload of 100 per cent.

In order to avoid having to make rule measurements when spacing the shear blades there is a large dial Q on the end of the short bed O in front of the reversing controller R, and on this dial are marked, to a magnified scale, inches sub-divided into eighths, covering the whole range of adjustment of the saddles. It will be observed that each of the saddles carrying the bottom shear blades has formed upon it a chute S to receive the cut bars as they fall from the blades and direct them on to the band of the conveyor T, which runs continuously along the front of the machine below the floor level, finally delivering the bars down a second inclined chute U into the skip V.

The general arrangement of the conveyor, which was built by the Ewart Chain Belt Company, Ltd., Derby, is shown clearly in the drawing. It consists of a horizontal steel slat conveyor 18in. wide, running at a speed of 190ft. per minute, and is driven by spur reduction gearing from an electric motor developing 12 brake horse-power at 770 revolutions per minute. Here, again, a safety slipping clutch is introduced into the third motion gear, to prevent damage to the conveyor in the event of any jamming. The conveyor band is supported by a rigidly constructed channel framing and cast iron rollers.

The shearing machine is double geared and fitted with a heavy fly-wheel, 72in. diameter, and the gearing is all of steel, machine cut, with the exception of the large spur wheel, which is of cast iron. The drive is by means of a compound-wound interpolar direct-current motor, developing 40 brake horse-power at 580 revolutions per minute and 60 brake horse-power at 750 revolutions per minute through cut steel gears running in an oil-tight sheet steel case. The machine is operated by two men, one standing at each side of the bar skid W. These men slide each bar in turn down the bar skid on to the blades of the multiple bar shear. The bars are cut into pieces, which fall down the chutes on to the conveyor, whence they are ultimately discharged endways into the skip V, which is suspended at the correct height, and in the proper position, by means of the electric traverser X. The shock of the falling bar is absorbed by a strong plate Y, fitted at the back of the trench behind the bar skip. This trench is made of sufficient length to accommodate two empty skips and two full skips, in addition to the skip which is being filled. The empty skips are put into the trench and the full skips are removed by the electric crane which runs along the full length of the mill and delivers the full skips to the different furnaces as required.



ELECTRIC TRAVERSER AND GRAB—CRAVEN BROTHERS

The electric traverser—illustrated on this page—is arranged to give a speed of 60ft. per minute along the trench, and the lifting speed at full load is 20ft. per minute. The traverse motion is operated by a reversing motor of 5 brake horse-power. The hoisting motion consists of four single part crane ropes, the end of each rope being secured to a strong cast iron barrel with turned grooves. Two of the ropes pass directly down to the skip-handling grab Z, referred to later, and the remaining two ropes pass across the crab over suitable guide sheaves down to the skip-handling grab. The end of each rope is attached to an adjustable shackle carried from the grab framework by universal shackles, so that the adjustable shackles are not subject to bending. The hoisting motion of the crab is operated through spur and worm gears from the hoisting motor. It is enclosed in a cast iron case, and has a magnetic brake of the "clip" type to take charge of the load. The coil of the solenoid of the brake is connected in series with the motor circuit, and is arranged so that when the current is cut off the brake immediately applies itself. In addition to the magnetic brake, the motor shaft is fitted with an automatic centrifugal governor brake of the air-cooled type, and an overwinding limit switch of the automatic self-replacement type prevents overwinding of the skip-handling grab.

This grab deserves special mention. It is designed to permit of picking up the bar skips and to put them down again without the use of slings. It consists of a substantial steel frame furnished with four lifting tongs, two on each side, carried on steel rocking shafts swivelling in bearings secured to the framework. The tongs are provided with connecting-rods and pins which are connected to a rocking link actuated by a screw and nut driven through spur gearing by a 1 horse-power reversing motor carried on the framework, a slipping device being interposed to prevent damage to the motor and gearing at each end of the movement of the tongs. The controllers and crane panel are carried on an operating platform placed adjacent to the conveyor mechanism at one side of the sloping chute, where the operator is in the best position to control the movement of the skip which is being filled, moving it from side to side and gradually lowering it as required. There are signal lamps to indicate the position of the skip with relation to the charging pit, and there is also a signal lamp on the shearing machine to warn the attendants that the skip is full, and that they must cease cutting whilst another skip is being placed in position.

The whole plant has been installed at the works of the Wolverhampton Corrugated Iron Company, Ltd., Ellesmere Port, where, we are informed, it is effecting a great economy in labour, and is giving great satisfaction to its owners. It should, in conclusion, be mentioned that the shearing machine and skip-handling grab are both fully protected by letters patent.

Improved Steam Turbines.

DURING the years 1908 to 1925 the Oerlikon Company erected in the Wood-lane Station of the Kensington and Notting Hill Electric Lighting Company a number of turbo-generator sets, with capacities ranging from 1500 to 3000 kilowatts, and within recent times the company has supplied new turbines to replace some of the original machines which had become obsolete, the original generators being retained. The station now contains Oerlikon turbines constructed at various dates, and good opportunities are afforded of comparing the performance of these machines, those installed within recent times naturally having a better efficiency than the older sets.

The first two Oerlikon generating sets were put into service in 1908. Each set had a capacity of 1600 kilowatts

TABLE I.—1908 *Turbine.*

Output of generator	Load.	Steam consumption (guaranteed)	Efficiency total.	Efficiency of generator	Efficiency of turbine.
K.W.	%	lb./K.W.H.	%	%	%
1600	100	16·49	57·7	93·25	62·0
1200	75	17·40	54·8	91·75	59·75
800	50	19·40	49·1	88·5	55·5
400	25	25·69	37·1	84·5	44·0

at a speed of 1500 revolutions per minute, a speed which in those days was common for such outputs. The turbines

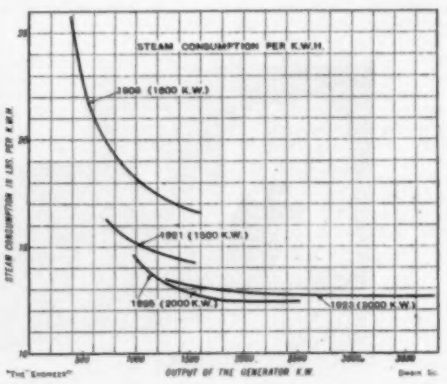


FIG. 1—STEAM CONSUMPTION PER KILOWATT HOUR

were supplied with superheated steam at a pressure of 160 lb. per square inch, and at a temperature of 482 deg. Fah. The vacuum was 28.20, with the barometer at 30in. The steam passed through nineteen pressure stages

with wheels having an average diameter of 49in., all enclosed in the same casing. In Table No. I., page 105, the guaranteed steam consumptions and efficiencies are given, and in the curves—Figs. 1 to 4—the actual steam consumptions and efficiencies are plotted for machines installed at various dates, as indicated on the curves. In these diagrams the efficiencies are based on the steam conditions in front of the inlet valve. The turbines belonging to the two original 1600-kilowatt sets have now been

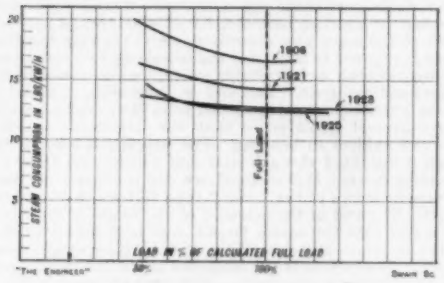


FIG. 2—CURVES OF STEAM CONSUMPTION

replaced by new machines, which are designed on modern lines.

In 1921 the Oerlikon Company supplied two 1500-kilowatt sets to meet additional demands on the station, the speed of these sets being 3000 revolutions per minute. The new turbines were designed to operate at a pressure of 185 lb. per square inch, and at a steam temperature of 585 deg. Fah., the vacuum being retained at the value stated. Table No. II. gives the figures which were obtained

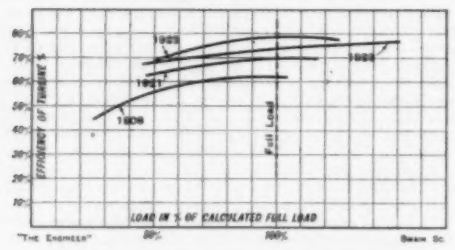


FIG. 3—TURBINE EFFICIENCY CURVES

during the official tests, whilst the steam consumptions and efficiencies are also plotted in Figs. 1, 2 and 3. As before, the efficiencies are based on the steam conditions before the inlet valve.

As a result of various improvements in design, the makers were in a position soon after the 1500-kilowatt machines had been installed to give better guarantees for their machines, the new features which were embodied

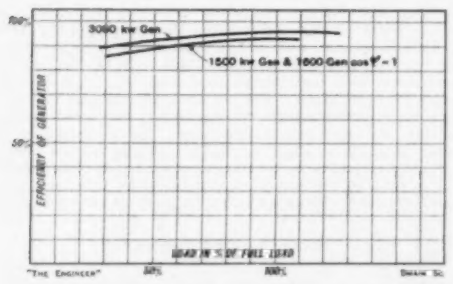


FIG. 4—GENERATOR EFFICIENCY CURVES

in the later 3000-kilowatt sets relating more particularly to the method of admitting the overload steam, as described in our issue of April 24th, 1922.

A view of a 3000-kilowatt set running at 3000 revolutions per minute in the Notting Hill station is given in Fig. 5. The normal load is 2600 kilowatts, but the output can be increased to 3000 kilowatts without increasing the steam consumption per kilowatt-hour. The admission of more overload steam enables the output to be increased to 3900 kilowatts, corresponding to an overload of 50 per cent. The official acceptance tests took place in October of 1923, the results obtained being shown in Table No. III., and also by the curves in Figs. 1 to 3.

The turbine efficiencies are here, as before, based on the steam conditions in front of the inlet valve, and the makers direct particular attention to the fact that the steam consumption remains practically constant from four-fifths to 50 per cent. overload, the average consumption being 12.6 lb. per kilowatt-hour. The increase in efficiency, as compared with that obtained in 1921, is very pronounced, the most notable feature being that with an increasing load the steam consumption and efficiency curves become increasingly favourable, even at loads above 100 per cent.

A comparison of the steam consumption curves of the 1600-kilowatt sets installed in 1908 with those of the plant put into service in 1921 and 1923, show that in the case of the new machines the steam consumption is far below that of the old plant, the difference amounting on an average to 15 and 23 per cent. Under modern conditions the old sets were very uneconomical, and could not be tolerated, even as stand-by sets, and it was therefore decided to replace the original turbines with new turbines running at 3300 revolutions per minute, whilst retaining the existing generators.

TABLE II.—1921 *Turbine.*

Output of generator.	Load.	Steam pressure at inlet valve.	Superheat at inlet valve.	Vacuum at outlet of turbine	Steam consumption.	Efficiency total.	Efficiency of turbine.
K.W.	Per cent.	lb./sq. in.	Deg. Fah.	In., merc.	lb./K.W.H.	Per cent.	Per cent.
1521	101·5	187·0	522	27·97	14·29	64·8	69·6
1162	77·5	187·1	508	28·24	14·79	61·5	67·2
748	19·7	185·5	495	28·47	16·11	55·9	63·2

TABLE III.—1923 *Turbine.*

Output of generator.	Load.	Steam pressure at inlet valve.	Superheat at inlet valve.	Vacuum at outlet of turbine (30in. bar.).	Steam consumption per K.W.H.	Efficiency total.	Efficiency of turbine.
K.W.	Per cent.	lb./sq. in.	Deg. Fah.	In., merc.	lb./K.W.H.	Per cent.	Per cent.
3728	143·5	184·7	545	28·00	12·55	73·1	76·4
3211	123·5	189·4	558	28·30	12·58	70·9	74·4
2478	101·0	186·8	559	28·47	12·71	69·1	72·9
1872	95·3	187·4	557	28·82	13·00	65·9	70·0
1281	72·0	186·6	558	28·98	13·46	62·0	68·0

TABLE IV.—1925 *Turbine.*

Output of generator.	Load.	Steam pressure at inlet valve.	Superheat at inlet valve.	Vacuum at outlet of turbine (30in. bar.).	Steam consump.	Efficiency total.	Efficiency of generator cos ϕ = 1.	Efficiency of gearing.	Efficiency of turbine.
K.W.	Per cent.	lb./ sq. in.	Deg. Fah.	In., merc.	lb./K.W.H.	Per cent.	Per cent.	Per cent.	Per cent.
2488	124·4	185·3	594	28·03	12·48	71·2	94·0	98·0	77·2
2028	101·5	185·2	592	28·09	12·41	71·6	93·5	97·5	78·5
1472	73·6	185·4	585	28·46	12·85	67·3	92·5	96·6	76·4
1000	50·4	185·1	562	28·43	14·48	60·3	90·5	95·4	69·8

TABLE V.—*Operation of Condenser.*

Quantity of condensed steam per hour.	Vacuum at inlet of condenser.	Temperature corresponding to the vacuum at the inlet of condenser.	Temperature of cooling water.		Saturation pressure corresponding to the outlet temperature of cooling water.	Quantity of condensed steam per sq. ft. and hour.	Heat transmission per sq. ft. cooling surface, deg. Fah. and hour.	Difference between the vacuum and the saturation pressure corresponding to the outlet temperature of cooling water.
			Inlet.	Outlet.				
lb./h.	In., merc. (30in. bar.)	Deg. Fah.	Deg. Fah.	Deg. Fah.	In., merc. (30in. bar.).	lb./sq. ft.-hour.	B.Th.U.	In., merc.
17,249	29·00	79·4	71·8	76·7	29·10	4·10	842	0·10
24,453	28·82	84·6	74·5	81·5	28·93	5·82	922	0·11
33,210	28·42	93·5	79·3	89·0	28·62	7·67	885	0·20
40,897	28·40	94·1	77·1	88·2	28·67	9·62	872	0·27
46,814	28·06	100·7	80·8	94·3	28·40	11·00	880	0·34

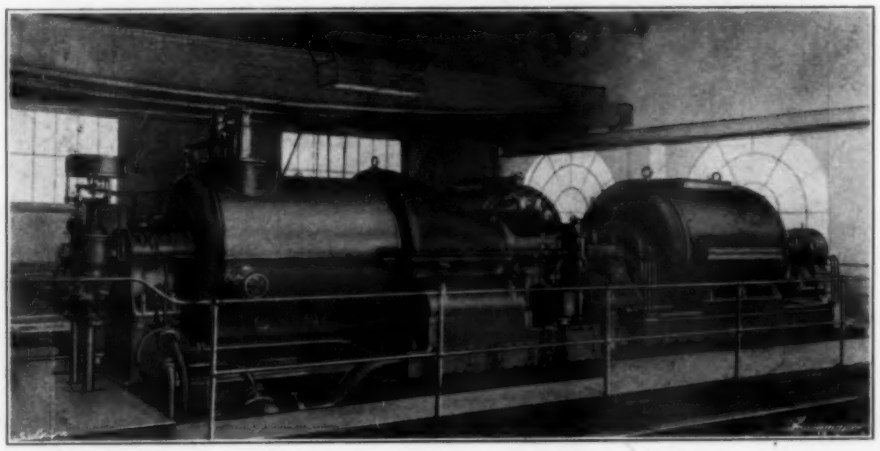


FIG. 6—2000 KILOWATT GEARED TURBO-GENERATOR

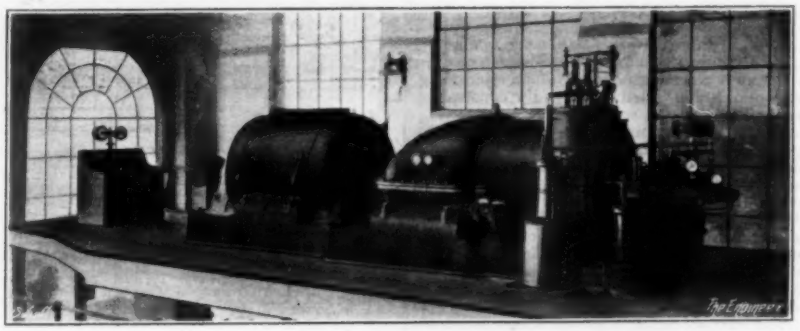


FIG. 5—3000 KILOWATT TURBO-GENERATOR

The plan of replacing the old turbines by new ones was one of the schemes associated with the conversions carried out by Mr. C. M. Bennett, chief engineer to the Kensington and Notting Hill Electric Lighting companies, with a view to reducing the cost of current production, and as a result the station now compares favourably with much larger stations in the matter of works costs. The Woodlane power station, which dates back to 1900, consisted originally of one building equipped with Willans and Robinson high-speed triple-expansion engines, coupled to Oerlikon electric generators, a second works, also designed by Mr. Bennett, being added in 1905.

The scheme for modernising the 1600-kilowatt sets, which was carried out in conjunction with the Oerlikon Company, provided for the retention of the existing condensing plant, as well as the original generators, the turbines being designed so as to necessitate as few structural alterations as possible. On account of the liberal design of the old electric generators, it was decided to increase their output to 2000 kilowatts. This did not, however, prevent the original condensers being retained, for by reason of the low consumption of the new turbines, they were still quite capable of dealing with the increased load.

On account of the fact, however, that the old generators were designed for a speed of 1500 revolutions per minute,

the new turbines, running at 3300 revolutions per minute, had to be provided with reduction gear. A view of one of the geared sets is shown in Fig. 6. The conversion of the sets is now complete, and the results have met all expectations. In fact, the steam consumption of the new 2000-kilowatt sets has proved even more favourable than that of the 3000-kilowatt sets installed in 1923, in spite of the fact that the generators of the former are of old design and are driven through reduction gears.

The test results are given in Table No. IV., page 106, together with the efficiencies of the reduction gears, which were supplied by Maag and Co., of Zurich. The results are also shown by the curves marked 1925 in Figs. 1 to 3, the throttling losses at the inlet valve being included. If the turbine efficiencies had been calculated for the steam conditions in front of the first diaphragm and the turbine losses alone had been taken into account, the efficiencies would have reached a value of more than 79 per cent.

For some of the turbines described the Oerlikon Company supplied the condensing plant, which, however, does not present any exceptional features, either as regards design or size, but a few particulars regarding the condenser

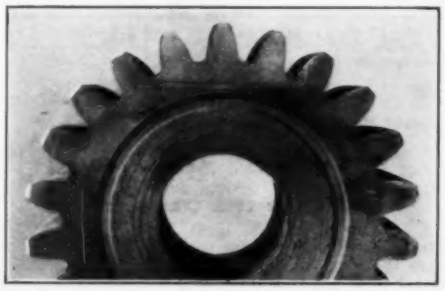


FIG. 8—MAAG GEAR WHEEL

for the 3000-kilowatt set in particular may be of interest. The condenser has a cooling surface of 4200 square feet, and is built as a two-flow condenser, and for dealing with 5650 gallons of water per minute. The air pump is of the ordinary rotary type, and is driven by an electric motor, together with the cooling water and condensate pumps. The results obtained on the occasion of the acceptance tests are given in Table V., page 106.

The vacuum values at the inlet of the condenser are average values obtained from readings with several instruments. By starting from the saturation tempera-

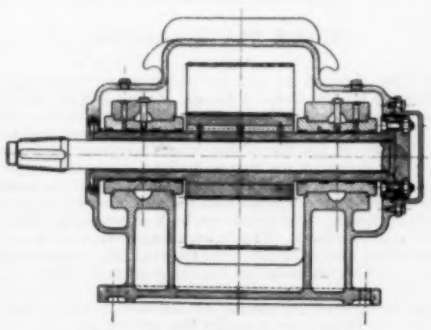


FIG. 9—SECTION THROUGH PINION

ture, corresponding to this degree of vacuum, the hourly heat transmission per unit of cooling surface and degree Fahrenheit difference in temperature, in relation to the average temperature of cooling water, are obtained, the figures arrived at being given in the table. These values, the Oerlikon Company points out, exceed the usual figures, and show that a high loading per unit of cooling surface is possible, without the difference between the vacuum attained and the vacuum corresponding to the outlet temperature of the cooling water becoming very large. In the curves—Fig. 7—the heat transmission figures and the differences between the actual vacuum and the highest vacuum obtainable theoretically have been plotted as a function of the load and cooling surface.

The gears are designed for transmitting a normal output of 3000 horse-power and an overload of 25 per cent., the main particulars being as follows:—Distance between centres, 1ft. $5^{23}/_{32}$in. (450 mm.); number of teeth, 54/119; modulus, 5.2; width of teeth, 1ft. $2^{11}/_{64}$in. (360 mm.). As shown in Fig. 8, the gears have straight teeth, which are believed by the makers, Maag and Co., to be superior to single or double helical gears for the transmission of large outputs at high speeds. In view of the

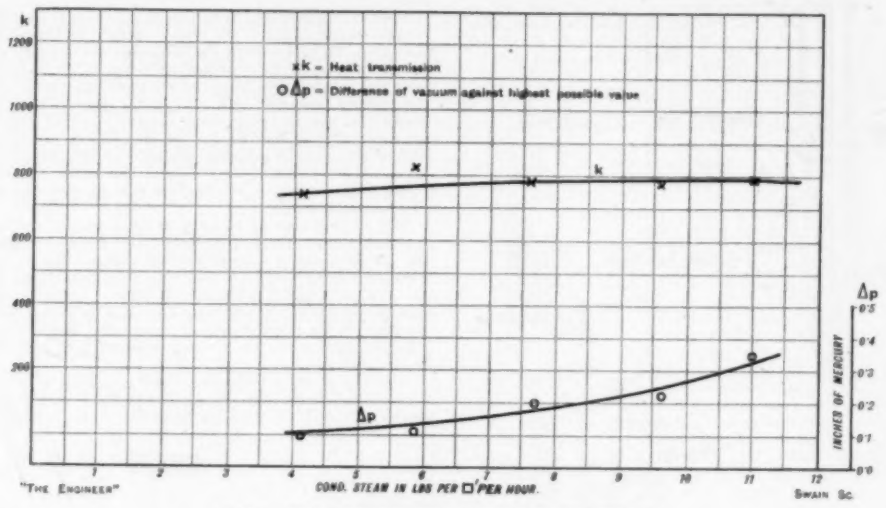


FIG. 7—HEAT TRANSMISSION AND VACUUM CURVES

fact that smooth operation is dependent upon the accuracy of the pitch and the shape of the teeth, the latter are carefully ground after the shaping process. By using a suitably shaped grinding wheel in conjunction with an adjusting device, which brings back the wheel automatically to its original position as it wears down, a very high degree of accuracy can be attained. In the case of the present gears, the maximum difference in pitch from tooth to tooth only amounts to a few thousandth of a millimetre along the periphery. The grinding of the face of the teeth also has the effect of hardening the teeth. These gears, with hardened and ground teeth, can be made small, and they have a very long life; in fact, it is said that even after they have been in use for several years the teeth do not show any traces of wear. The rims of the pinion and spur wheel are made of chrome-nickel, with 3–4 per cent. nickel. The gears are subjected to the usual case-hardening process, and in order that the face of the teeth may alone have hard surfaces and the other parts of the wheel may remain soft, the outer layer is turned off after the hardening process. After this process, the characteristics of the material under the hardened layer are as follows:—Limit of elasticity, 63.5 tons per square inch; tensile strength, 76.2 tons per square inch; and elongation, 8 per cent. A section through the pinion is given in Fig. 9. The gears are driven by the turbine through a flexible shaft, which passes through the hollow shaft of the pinion and is bolted to the latter as shown.

The flexible shaft is connected to the turbine shaft by means of a rigid coupling, since displacement of the pinion in the axial direction as a result of the expansion of the turbine shaft, is quite permissible in the case of gears with straight teeth. The fact that it is unnecessary to use a coupling that is capable of moving axially is considered by the makers to constitute a considerable advantage over double helical gears, and leads to great simplification.

Books of Reference.

The Concrete Year Book, 1926, now in its third year of publication, has undergone certain modifications with the object of increasing its utility as a book of reference and of bringing it thoroughly up to date. Several chapters have been omitted and the space thus made available devoted to matters of current interest. As at present arranged the volume is divided into eleven chapters, a Directory Section and a Catalogue Section. The titles of the chapters are as follows:—I., "Cement;" II., "Essential Factors in Making Good Cement;" III., "Tables for Reinforced Concrete Design;" IV., "Concrete Floors;" V., "Water Towers;" VI., "American Standard Specification for Concrete and Reinforced Concrete;" VII., "Surface Treatment of Concrete;" VIII. "Concrete Roads;" IX., "Memoranda for Concrete Users;" X., "Bibliography of Concrete and Reinforced Concrete;" and XI., "Professional Institutions and Trade Associations." A useful feature which we notice is that a dozen pages or so are devoted to trade names and brands, with the names and addresses of the manufacturers concerned. These names refer mostly, but not exclusively, to cement, concrete and kindred subjects. Altogether this year's edition would appear to be a decided improvement on those which have gone before it. The book is obtainable from Concrete Publications, Ltd., 20, Dartmouth-street, Westminster, S.W. 1, price 2s. 6d. net.

The Manual of Electrical Undertakings and Directory of Officials, 1924–1925, which is probably more generally known as "Garcke's Manual," appears this year in its twenty-eighth annual issue, and is so well known that it really needs no word of introduction from us. The present issue contains particulars of no less than 3180 electrical undertakings, the data given including financial, technical, commercial and general information, and from it we learn that the aggregate capital issued by electrical companies registered in Great Britain, in shares, debentures and loans—together with the amounts borrowed by municipalities for electrical undertakings—now amounts to the large total of £719,201,959. The contents of the present volume, following an account of the progress made during the financial year 1924–25 and a statistical analysis, are divided as follows:—(1) Electric Supply and Traction; (2) Telegraph and Telephone; (3) Manufacturing and Miscellaneous; (4) Dominions and British Possessions; (5) Directories of Officials, of Members of Electric Lighting and Tramway Committees, and of Electrical Contractors; and (6) Index of Undertakings. The undertakings in Overseas Dominions about which information is given include those in Canada, Central America, the West Indies, Africa, Australia, New Zealand, India, and British Possessions in Europe and Asia. There are in all twenty-eight maps, which include those of the principal electric tramway systems, of the electrified railways, of power undertakings, of the areas of the Electricity Districts provisionally determined by the Electricity Commissioners, &c. There is also a useful buyers' guide. The Manual is published by the Electrical Press, Ltd., of 13-16, Fisher-street, Southampton-row, London, W.C. 1, price 35s. net.

The "Practical Engineer" Mechanical Pocket Book and Diary for 1926 has just appeared in its thirty-eighth edition, and we notice that in it several new features have been introduced. For instance, it now contains a section devoted entirely to the Design and Operation of Workshops. Then, too, the notes on "Toothed Gearing" have been entirely re-cast, and to a considerable extent re-written, as have also the "General Notes on Engines of the Diesel Type." In addition, the notes included in former editions have, we are informed, been amplified by the introduction of new matter relating to steam traps, vacuum traps, feed-water heaters, turbo pulverisers for coal, water-tube boilers, air heaters, calorifiers, strainers, friction clutches, foundations, lifting tackle and pyrometers. Improvements are also noticeable in other directions. The book also contains a buyers' guide and short technical dictionaries in French, Spanish, and Russian. The utility of the latter might be increased if, instead of only giving the English equivalents of the foreign words, there were also included the foreign equivalents of the English words. The book is published by the Oxford University Press, Technical Department, Falcon-square, London, E.C. 1, price 2s. 6d. net cloth, 3s. net pluviusine.

The Colliery Manager's Pocket Book, Almanac and Diary for the Year 1926 has now reached its fifty-seventh year of publication. In outward appearance it is identical with the issues which have preceded it, but actually it embodies several novelties. For example, the chapter on coal has been entirely rewritten, and in all the remaining sections new matter has, we learn, been introduced or the text carefully revised. Every endeavour, so an introduction tells us, has been made to render the contents quite up to date to within a few weeks of the time of publication, and the different sections have been recast in the light of new legislation, experience and research. The chapter on "Mining Progress During 1925" contains much interesting reading. The Pocket Book is published by the Colliery Guardian Company, Ltd., of 30 and 31, Furnival-street, Holborn, London, E.C. 4, in three forms: cloth, 3s.; roan, gilt edges, 4s. 6d.; and calf, gilt edges, 6s.

A BRITISH CIMENT FONDU FACTORY.

WE were invited by the Lafarge Aluminious Cement Company, Ltd., to attend on Friday of last week a luncheon given at the Savoy Hotel, to celebrate the commencement of manufacture of Ciment Fondu in this country. Hitherto the material has been only made in France, but since the first of this month there has been in operation, at West Thurrock, in Essex, a factory which is entirely British in every respect, having been erected of British material, being equipped with British plant and machinery, and being operated exclusively by British workmen.

As our readers are aware, Ciment Fondu is a cement containing a high percentage of alumina, and possessing the characteristic of hardening very rapidly. Briefly stated, it may be said that it is produced by smelting a mixture of chalk or limestone and bauxite, and it differs from Portland cement, not only in its composition, but because the raw materials are actually fused or melted, whereas the constituents of Portland cement are not heated to nearly such a high temperature.

The new factory, which is described as being the only example of its kind in the world, has been designed for an ultimate output of 150,000 tons of cement per annum. For the present, however, the capacity of the plant is 40,000, or, say, 110 tons per day. It stands on a site of about 7 acres in extent, and, so far, £130,000 has been spent on it. The constructional work was carried out under the supervision of Mr. R. R. Woodcock, the company's chief engineer. The steel structures were supplied by Heenan and Froude, Ltd., and Nissens, Ltd.; the crushing and screening plant by Ernest Newall, Ltd.; the briquetting plant by Wm. Johnson and Sons, Ltd; the lime kilns by Priests Furnaces, Ltd., and the grinding plant by Vickers Ltd. The special furnaces for treating the lime, bauxite, &c., were also built by Priests Furnaces, Ltd. The works are electrically-driven throughout, the necessary current being obtained from the Barking Station of the County of London Electric Supply Company, Ltd.

MOTOR GENERATOR SETS AT THE RUGBY WIRELESS STATION.—In referring to the amplitude of harmonics or tooth ripples in the voltage of the motor generator sets at the Rugby station, described in our issue of January 8th, the decimal point was omitted, the correct value being ± 0·5 per cent. The British Thomson-Houston Company has also asked us to make it clear that the 87·6 per cent. efficiency applies to the complete sets, but we scarcely think that any of our electrical readers took this figure to apply to the generators alone,

Two-Stroke Crude Oil Engine.

WE recently had an opportunity of inspecting the manufacture, erection and testing of the ingeniously designed two-stroke vertical crude oil engine, which was put on the market for the first time early in 1924 by Crossley Brothers, Ltd., Manchester. The first engine of this type to be shown was exhibited at Wembley in 1924, and we are informed that it ran daily throughout the duration of the Exhibition with only one stoppage for adjustment. As the engine has not yet been fully described, some particulars may be of interest even at this late date.

In producing this engine the main object was the elimination of the defects inherent in the smaller types of two-

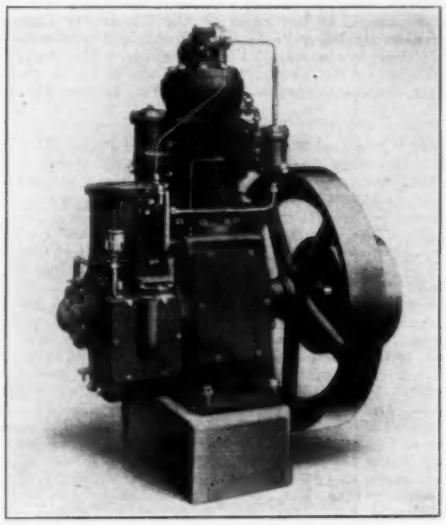
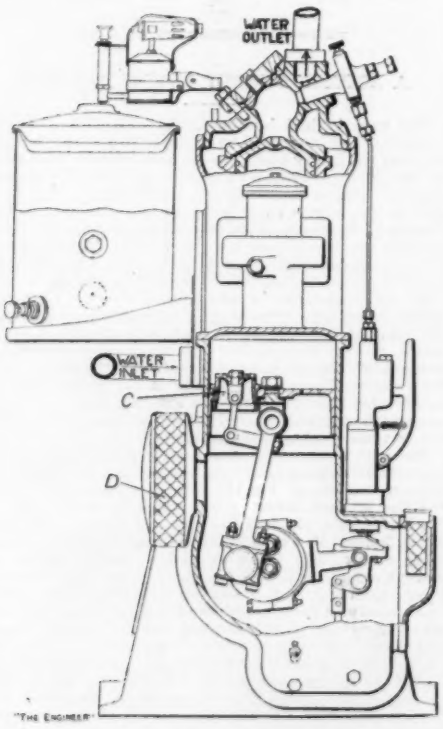


FIG. 1—14 B.H.P. TWO-STROKE CRUDE OIL ENGINE

stroke crank-case compression engines, and, although the makers would appear to have sacrificed simplicity to some extent by the addition of a separate scavenge pump, the extra mechanism is of a very simple kind and requires but little power for its operation. The external appearance of the engine is, therefore, somewhat misleading, as the vertical cylindrical casting attached to the left-hand side of the engine—and seen in Fig. 1—is only for the slight compression and admission of the scavenge air to the working cylinder. The lower portion of the scavenge cylinder casting contains the fuel oil and lubricating oil pump mechanism and the centrifugal governor.

The details of the internal mechanism are clearly shown in the sectional views—Fig. 2. The scavenge pump casting



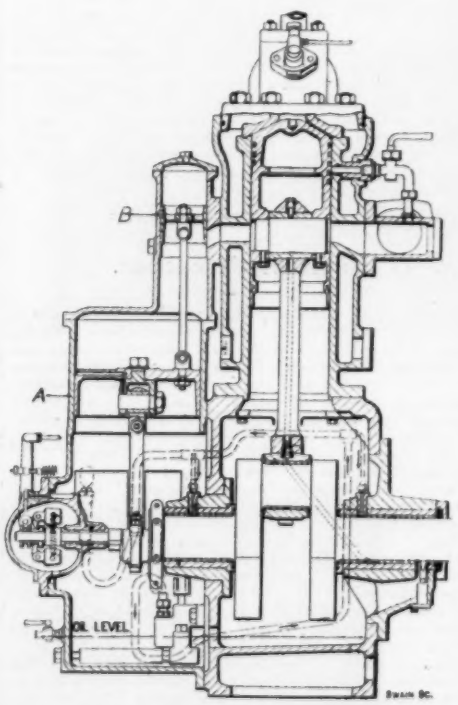


FIG. 2—ARRANGEMENT OF TWO-STROKE CRUDE OIL ENGINE

A—Fig. 2—is attached to the side of the engine frame. The lower portion is the cylinder, and contains an aluminium piston driven by a short crank on an extension of the main crank shaft. The upper cylinder B contains a transfer valve for opening and closing the admission port to the working cylinder. The suction valve for admitting air to the space above the large scavenge piston is marked C. It is an aluminium piston which works in a sleeve in the large piston, and is operated by a link from the connecting-rod in such a way that it is caused to open when the piston is descending, and to close when the latter is compressing the charge of air. It should be stated that the scavenging air is only compressed in this cylinder to a pressure of 1 lb. to 2 lb. per square inch, and is drawn into the space above the oil-well through the silencer D. All the parts of the scavenging mechanism are extremely light, and there is little or nothing which is liable to get out of order, but in case of need the mechanism is easy of access. The joint

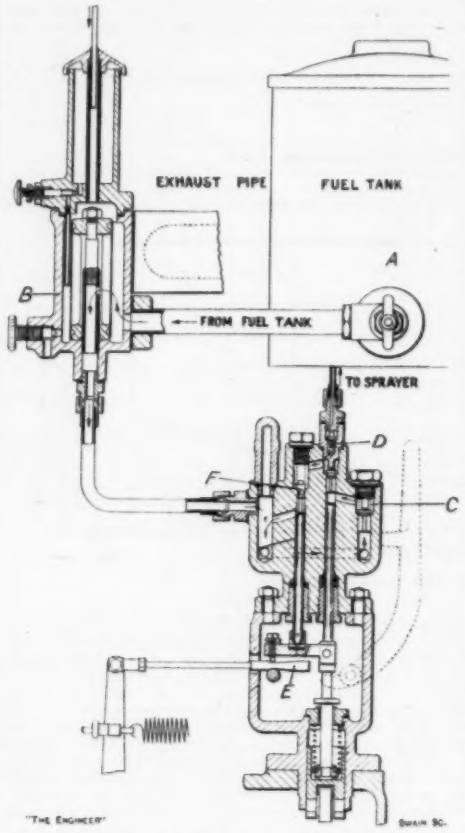


FIG. 3—FUEL PUMP AND FUEL HEATER

between the main cylinder head and the cylinder is made with a copper ring, and the joint between the water jackets of the cylinder head and cylinder is made with a round rubber ring which permits contraction and expansion of the cylinder to take place without danger.

The governor is mounted on an extension of the crank shaft, and is contained in the space above the oil well. It is of the centrifugal type, and operates a lever which is attached to a wedge that regulates the opening of the fuel control valve. A sectional view of the fuel pump and fuel heater is given in Fig. 3. The crank shaft mechanism for driving the fuel pump, lubricating pump and scavenging pump comprises a simple excentric crank disc and pin secured to the end of the main crank shaft, the pin operating the scavenge pump and the excentric disc operating both the fuel and lubricating oil pumps—as shown in Fig. 2. A small drag link fitted at the end of the scavenge pump crank pin drives the centrifugal governor.

The operation of the fuel pump and governor can be more clearly followed by reference to Fig. 3. The fuel passes from the tank A to the heater B through wire gauze, and thence to the suction valve C in the fuel oil pump. The pump plunger delivers the oil through the delivery valve D to the sprayer, the supply of oil being controlled by the governor mechanism and wedge E which acts upon the valve F. As the load on the engine increases, or the speed falls, the governor wedge moves from the left to the right and *vice versâ*. In consequence, the control valve in the pump is opened sooner or later as desired. The pump may be operated before starting by means of a hand lever.

The fuel sprayer—shown in section in Fig. 4—is of fairly simple construction. The valve spindle is lifted off its seating by the pressure of the oil during the delivery stroke of the oil pump, thus permittting the oil to be injected into the combustion space in an atomised form. When the control valve F—Fig. 3—opens, the sprayer valve closes and the spraying stops instantly. The lift of the sprayer valve is limited by the shoulder near the outer end of the spindle pressing against the stop bush, which contains the helical spring shown, the latter being compressed sufficiently to give the best average result by means of a nut and washers.

When using viscous fuel oils an arrangement is provided for enabling the engine to be started up on gas oil or paraffin oil. It comprises a container situated above the oil heater, communication between the two chambers being made by means of small ports and a valve. Before stopping the engine a cock on the main fuel tank is closed and the starting valve opened, which allows the lighter fuel to pass through into the heater compartment and thence to the fuel pump.

The frame on which the power cylinder is mounted is provided with large doors at the back and front for inspection and adjustment purposes. The cylinder and

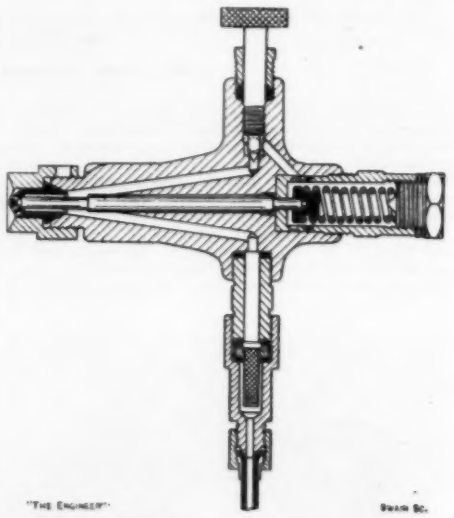


FIG. 4—FUEL SPRAYER

water jacket form a separate casting, and the upper end, where the temperature is highest, is designed in such a manner as to be free from casting stresses. The cylinder head is also water jacketed, the inner and outer walls being separated where they are attached to the cylinder, thereby allowing freedom for contraction and expansion. The system of forced lubrication to the engine consists of a plunger pump, provided with ball valves, is fitted in the oil well, and delivers oil under pressure to each of the main bearings, as well as to the big and small ends of the connecting-rod.

The following particulars with regard to fuel consumption of the 14 brake horse-power engine—Fig. 1—working at the normal rated load have been supplied by the makers, Paraffin, 0·51 lb. per brake horse-power; gas oil, 0·53 lb. per brake horse-power; Diesel oil, 0·55 lb. per brake horse-power; furnace oil, 0·57 lb. per brake horse-power.

INDIAN STATE SALOONS.

A PAIR of broad gauge bogie saloons has been recently completed by the Eastern Bengal Railway in the Kanchrapara Carriage and Wagon Shops, to the designs of Mr. H. H. Spalding, locomotive and carriage superintendent, for the use of his Excellency the Governor of Bengal. They are designed for day and night use with complete arrangements for supplying meals *en route*, and are carried on 67ft. underframes fitted with four-wheeled bogies of the I.R.C.A. design. The bodies are built of especially selected teak, well seasoned. The main saloon contains bed and bath rooms and a dining room for their Excellencies, and the second accommodation for the staff and servants and a kitchen.

The interior of the saloons are finished in teak, some of the panels being exceptionally fine specimens.

The kitchen and pantry probably called for the most ingenuity of designing and fitting, as arrangements had to be made so that the compartments could be thoroughly cleaned and washed out, also for carrying large quantities of provisions and ice as well as the usual crockery for twelve persons. The first was obtained by completely lining both compartments with Calbonite and covering the floors with Decolite. Calbonite was also used for lining a large ice chest, which was built into the pantry under the dresser, it being found that Calbonite was a good non-conductor of heat. The floors of the main saloon and sleeping compartments are, it is interesting to note, packed with a composition made of waste from the sand-papering machine—which was found to deaden sounds very effectually.

Provincial Letters.

THE MIDLANDS AND STAFFORDSHIRE.

(From our own Correspondent.)

Market Position.

LAST week's quarterly meeting has thrown little light on the industrial prospects for this district. There was no large amount of buying, and except in the case of pig iron there were no price alterations. True, the hopeful tone which has existed on the Birmingham market since the year opened was, and is, maintained, but orders have been increased hardly at all. Both buyers and sellers exercise the greatest caution and are reluctant to negotiate far ahead. This week there has been no change in the situation. The outlook is obscure, but hope for increased business as the quarter advances is maintained.

Pig Iron Values.

It was very noticeable at last week's quarterly meeting that blast-furnacemen were in no mind to pay out of their own pockets the increase in coke prices which the ovenmen are enforcing. They would rather produce pig iron in such quantities as will serve for the exploitation of affiliated plants and ensure an economic return for supplies disposed of on the open market. The conditions which prevail in the smelting industry distinguish pig iron from the other departments of the market. Consumption has increased and stocks at furnaces have been absorbed to a great extent, so that some producers are unable to give prompt delivery. The improved demand is reflected in the December returns of production, amounting to 503,400 tons, comparing with 494,100 tons in November. This is the best total since last June. The rate of output is probably sufficient for current requirements, but in any case the margin is slender. With coke 1s. 6d. to 2s. dearer than in the last three months of 1925, and all the uncertainties of the coal situation in the background, the policy of kindling more furnaces is discouraged. It came as no surprise therefore when Midland smelters announced that they would require an additional 1s. to 1s. 6d. per ton for their products. There was no rush to buy, but most of the business put through carried an addition of about 1s. to the prices previously prevailing, and this increase has been maintained this week. One make of Derbyshire foundry is offered at £3 3s. at furnaces, but for the rest the quotation is £3 7s. The price of Northamptonshire foundry is generally based on £3 4s. Forge is in small demand. Derbyshire furnaces want £3 2s. 6d. to £3 3s., and Northampton £2 16s. to £2 17s. Lincolnshire basic is up 1s. to £3 5s. East Coast hematite reflects the recent appreciation in the North, being quoted at £3 15s. to £3 16s. It is not to be inferred that buyers acquiesce in these advances. Many of them are "holding off" for the time being. It remains to be seen whether the consumer will pay the higher price or curtail his buying. Unexpired contracts afford only a very slender refuge. They insure supplies for a few weeks to a certain number of customers, but unless they are renewed, consumers will have to take their chance in hand-to-mouth buying.

Bar Iron.

Bar iron business improves, but does so only slowly. Orders at last week's quarterly meeting were not up to expectation. This district is unfavourably situated for export, a class of business largely captured by Derbyshire and Lancashire. Some orders for railway material are helping to maintain a somewhat improved market tone, however, and the makers of marked bars report a better business outlook. This year orders have come in on a steady basis, and £14 is obtained without difficulty. An advance is to be noted in general engineering demands; and more manufactured iron is going into the rolling stock works. Recent quotations of Staffordshire unmarked bars of Crown quality and iron of nut and bolt qualities are unaltered. They are, to a large extent, nominal, and the Lancashire rates of £11 10s. and £10 10s. respectively are being accepted by Staffordshire ironmasters. Iron strip may be bought at from £12 5s. to £12 10s. No. 3 Belgian iron for nut and bolt making is very difficult to obtain, but Staffordshire iron costs about £4 more, and makers are increasingly utilising steel as the base material.

Steel.

The steel trade has a brighter outlook, with inquiries somewhat more numerous, and practically all the mills are making larger production. Internal competition still frustrates attempts to put prices on a sounder footing, however. Sections can be bought down to £7, and ship, bridge and tank plates down to £7 15s., although most makers want 2s. 6d. more, even in the case of good-sized orders, and for smaller lots they quote £7 5s. and £8 respectively. For small steel bars £7 17s. 6d. is accepted. Soft billets command £6 to £6 2s. 6d. The position with regard to continental steel has changed materially. The French and Belgian works are now asking higher prices, and deliveries are further receding. In some cases it is impossible to get satisfactory assurances of delivery before April or May. For foreign billets £5 7s. 6d. is the bottom price, £5 10s. having been paid.

Galvanised Sheets.

The market for galvanised sheets is less active. There is no longer much difficulty in getting quick deliveries. Some of the mills have still considerable reserves of orders, however, and prices range from £16 10s. to £16 15s. for corrugated sheets of 24 gauge. Black sheets are in moderate request, and values are firm.

Tinned Sheets.

The Tinned Sheet Manufacturers' Association has reaffirmed prices at £2 18s. per cwt. for best charcoal, £2 16s. for charcoal, £2 12s. for unassorted grades—to 20 gauge in each case.

Scrap.

Steel scrap prices are slightly firmer, £3 7s. 6d. delivered South Wales now being the minimum. An additional 2s. 6d. is said to have been obtained for quick deliveries.

Australia Wants Chain Cable Makers.

An effort to develop heavy cable chain making in Australia has led to an appeal for workers in that trade to emigrate from Cradley Heath, the chief centre in England. A few days ago a letter was received at Cradley Heath from the head of a firm in Brisbane, stating that he has vacancies for eight married men with families, capable of making chain of sizes from ¾in. to 1¼in. The wage offered is £5 per week, and the writer is prepared to advance the money for the passage. This letter has been handed to the local employment exchange. Mr. C. H. Sitch, secretary of the Chain-makers' and Strikers' Association, does not look favourably upon the matter. He states that the type of man that Australia is asking for would have to be of the best class they had in Cradley Heath, and they would be no better off than in this country as a good block chain-maker, or one accustomed to make Admiralty work, received nearly the same wage in this country, where living is cheaper than in Australia. Further, he points out that the climate of Australia is not conducive to good chain-making, and a man would find difficulty in producing good-quality chain with the fuel obtainable there. It is well remembered in the Cradley Heath district that a few years before 1914 Germany tried to establish the chain cable trade by importing Cradley Heath labour. Indeed, she actually succeeded in inducing just a few highly skilled operatives to go over. But neither masters nor men in South Staffordshire wanted to loose the chain cable trade to the foreigner, and in almost less time that it takes to record it, the unwary Cradley Heath workers were back in their own shops. The explanation was that when it was learned that the men had left for Germany, the president and secretary of the Operative Chain-makers' Union followed post haste, and brought them back immediately. The present invitation from Australia is viewed by the officials in the chain trade much in the same light as was that of Germany.

Electrification.

The Government's electricity proposals as outlined by Mr. Baldwin in Birmingham on Friday have a special interest in South Staffordshire, for the scheme, in principle, is very similar to that which it has been decided by producers and distributors in the West Midlands to put into operation in their own area. The principle differs in that the Midland scheme pools the resources of all generating stations, while the national plan would make use of only those which come in the category of super-stations. The rest would remain merely as distribution centres. If the larger project which the Prime Minister explained in his Birmingham speech receives legislative sanction in the coming session, it is not likely that the Black Country scheme will be duplicated elsewhere, as until now had been expected, for the new proposals provide for a much wider application of co-ordination in the generation of electric power. It is felt, however, that, organised as it now is, the district covered by the West Midlands scheme will not have to undergo any drastic changes in the near future.

Inland Waterways.

Mr. P. J. Hannon, who presided over a meeting of the Executive Committee of the National Council for Inland Waterways at Birmingham on Friday last, said that the past two months had seen a distinct and encouraging stimulation of interest in the efforts of the National Council to further the maintenance of an adequate and efficient canal and waterway system in this country. The secretary's report showed that since the last meeting acceptances of membership had been received from seven local authorities, ten trades organisations, three Chambers of Commerce, and twenty navigation companies and firms, the last-named being representative of such varied interests as coal, iron and steel, chemical products and bricks. The matter of cheap and efficient transport is of such vital importance to this district that the information is welcomed as a further step in the right direction.

Redundant Coal Pits.

The restoration of the coal-mining industry is of vital importance to the Midlands and Staffordshire, and keen interest is manifested in all aspects of the matter. There is in this part of the country increased agreement in the necessity of relieving the coal-mining industry of properties which in the changed circumstances of to-day cannot be regarded as economic propositions from the point of view of the community. In this connection, an interesting suggestion is made by Sir Francis Joseph, the President of the North Staffordshire Colliery Owners' Association. It is that redundant pits should be extinguished from a compensation fund in the same way as redundant public-houses are got rid of. The idea should, at any rate, help to focus attention on an aspect of the problem which demands more attention than it has received hitherto.

The Glass Industry and Safeguarding.

A national conference of employers and workmen concerning the glass industry was held at Birmingham on the 13th inst., to consider the question of initiating a new movement for securing recognition of the claims of the industry to protection against the foreign competition which is threatening its stability. The view was expressed that the application previously made could only have been rejected through inappreciation of the situation of the industry, and its importance from a national standpoint as was shown during the war. The conference adopted a resolution in favour of steps being taken to promote a further application.

Railway Contracts.

The Metropolitan Carriage, Wagon and Finance Company, Ltd., of Saltley, Birmingham, has again added materially to its order books. The Crown Agents have placed with it an order for thirty brake vans, thirty passenger coaches, and three dining saloons for the Uganda Railways.

Presentation.

An interesting presentation was made last week in the Black Country. Mr. William Hutchinson, jun., the former managing director of Alfred Hickman, Ltd., Springvale Steel Works, Bilston, being the recipient of a silver tea and coffee service, together with silver salver bearing the inscription: "Presented to William Hutchinson, jun., Esq., by the workmen of Alfred Hickman, Ltd., Springvale Works, as a token of their regard upon his retirement, 1925." Mr. Hutchinson had been associated with the works for some thirty-eight years, having risen first to manager and later to managing director of what is now one of the largest and most successful works in the Midlands. He is well known and highly esteemed in Midland industrial circles.

Unemployment.

A substantial decrease in the number of wholly unemployed workers in the Midland area is recorded in the latest statistics. The current total of 139,661 compares with 147,461 in the previous official return, while of those temporarily unemployed the total is 49,836, as compared with 53,887.

LANCASHIRE.

(From our own Correspondents.)

MANCHESTER.

General Outlook.

THERE was a fair attendance on the Iron Exchange to day—Thursday. The general position, so far as pig iron is concerned, has become rather complicated, owing to the discussion concerning future coke prices, which are still unsettled, views of buyers and sellers being still widely apart. This is causing the local founders to hold off from placing contracts for future delivery, and therefore only a hand-to-mouth business is passing at the moment. Prices on spot show little change, but there is a distinctly good undercurrent and prices are against buyers where business is put through. West Coast hematite is 2s. to 3s. per ton higher on the week, and on the East Coast it has again advanced by 3s. per ton. Stocks in the Cleveland district are low, and it is reported that producers are not booking orders for immediate delivery, as the output is being outstripped; they are heavily in arrears. No. 3 G.M.B.'s are quoted as high as 69s. 6d. per ton f.o.r., this being the third advance during the past three weeks. In foundry iron, as already indicated, there has been no great weight of business put through, but prices in this section were generally 1s. to 1s. 6d. above last week's level. In Lincolnshire No. 3 there was some tension, and it was quoted 75s. per ton, delivered Manchester. Scotch No. 3 was not much in evidence, and was quoted 96s. per ton, delivered Manchester. Derbyshire No. 3 was around 76s.; Northamptonshire was not quoted, as there are practically no arrivals here.

Scrap.

Heavy steel melting scrap was fairly steady at 75s. per ton; ordinary broken machinery scrap being 2s. 6d. per ton lower. Special textile scrap was 75s. per ton.

Manufactured Iron.

Manufactured iron and steel show little change. The Birmingham quarterly meeting has already found an echo here, and has inspired a certain amount of confidence which augurs well for the future. Any talk of the American boom has subsided to a large extent, and if it came it would scarcely affect this centre. Full quotations will be found in the list of current prices.

Manchester Association of Engineers.

A paper, entitled "The Electric Drive of Reciprocating Machine Tools," was read before the Manchester Association of Engineers on Friday, January 15th, by Mr. L. Miller, A.M.I.E.E. The author subdivided his paper into sections, dealing with (1) the characteristics of cutting tools; (2) characteristics of the power medium; (3) the development of the single motor drive; (4) requirements of the modern drive; (5) power taken over the cycle; (6) the effect of a high-speed return; (7) a comparison of the Ward-Leonard and single motor drive; and (8) the cost of operation of various planing machines. He showed oscillograph curves taken from planing machines to demonstrate that on short-stroke work the planer table cannot achieve full speed before reversal takes place with either the Ward-Leonard or single motor drive. The curves showed that the saving in time between a return speed of, say, 100ft. per minute and one of 150ft. per minute amounted to not more than 8 per cent. on large planing machines, while the power required to return the table at 150ft. per minute is 50 per cent. more than that required to return it at 100ft. per minute. A further objection to returning the table at such high speeds was that it increased the difficulty of securing the work in such a way as to ensure that it would not move when accelerated and retarded rapidly. For this reason the machinist rarely used the high-speed return. In order to get a high-speed return of, say, 150ft. to 180ft. per minute, with a minimum cutting speed of 25ft. by shunt field control, it would be necessary to use a Ward-Leonard equipment, since the single motor drive only gave about 100ft. per minute with a minimum of 25ft. per minute by shunt field control. The extra cost compared with a single motor equipment would be approximately 70 per cent., and it would be difficult to justify such an outlay. The difficulty was further increased when it was realised that if heavy cuts at slow speeds could be taken,

the single motor equipment was capable of removing considerably more metal in a given time than its rival. Summing up, the author said that the use of a Ward-Leonard equipment could only be justified under the following circumstances:—(1) Where there was no direct-current supply and the amount of current required did not justify putting down converting plant to supply current to a number of direct-current motors operating machine tools; (2) when operating on very light work where heavy cuts were impracticable. The paper was illustrated by a number of diagrams.

Manchester Chamber of Commerce.

At a meeting of the engineering and metals section of the Manchester Chamber of Commerce held last week, Sir Benjamin Longbottom was re-elected chairman, Mr. L. F. Massey Vice-chairman, and Mr. H. Allcock honorary secretary of the section for the ensuing year. In the Chamber's annual report attention is called to the discrepancy between the relatively high wages paid to-day in the "sheltered trades" and the unsheltered engineering industry, which is exposed to the full force of foreign competition in nearly all its branches. This is mentioned as a fruitful source of labour unrest which militates against the desired recovery. Export prices are said to have been very low, and the assistance afforded to their foreign competitors by their longer hours of working, lower real wages, and depreciated currencies has given and is still giving grounds for serious concern amongst British firms. The report further states that in the iron and steel trades plant is still being operated below its normal output, but an increased volume of business was secured during the closing weeks of 1925. An improvement was also reported in the locomotive and constructional engineering sections. The textile machinery industry continued to feel the effects of the depressed conditions of the cotton and woollen trades in the home market, but it is expected that the rapid development of the artificial silk industry will materially benefit this section.

BARROW-IN-FURNESS.

Hematite.

The hematite pig iron trade in the north-west district maintains its tone, but there are no new developments to note. The position is one of gradually growing optimism, with just a dash of caution, some agents feeling rather uncertain of the market in the future. One merchant has expressed the opinion that he cannot understand where all the orders are coming from, but he probably had not made sufficient allowance for the improvement in engineering generally, which no doubt is responsible for the amelioration which has taken place during the last month or two. The Midlands and Scotland continue to be the best customers, but there is also a moderate dispatch to Wales. The Continent does not count for much at present, the rates of exchange operating against business to some extent. American trade is up and down, but further business is possible. The charcoal furnace at Backbarrow is producing high qualities of iron, but is not always on charcoal. Ordinary fuel is used on occasions, but the iron is of special analysis, and of very high quality, intended for special requirements.

Iron Ore.

The iron ore trade in the district continues about the same, with a slight tendency to improve with users outside the district. The Cumberland mines are experiencing the better trade, but none of them are what might be actually considered busy. Foreign ore is in moderate demand, but there will be an improvement shortly.

Steel.

There is a slightly better outlook in the steel trade. There is more life in the market, and it is anticipated that the rail mills in this district will get their share of orders placed. The Workington mills have a fair amount of work to do, but are not quite booked up for regular running. The Barrow mills have orders to keep them going for nearly three months. The hoop and small section mills at Barrow are fairly well placed.

SHEFFIELD.

(From our own Correspondent.)

Steel Works Quiet.

CONDITIONS in the heavy steel trade at the moment are not reflecting the optimism that was freely expressed towards the end of last year, and which is still to be met with in manufacturing circles. Brighter patches are to be seen here and there, but, on the whole, it would appear that the heavy branches are actually quieter than before the holidays. Buyers are displaying great cautiousness and are still adopting the policy they have followed for so long of securing just sufficient supplies to carry them on from week to week, and in some cases it might almost be said from day to day. The departments which are most depressed are those producing semi-manufactured basic steel, wire rods and bar iron, and the severity of foreign competition is largely responsible for this state of things. The contract for rails for the London and North-Eastern Railway which has been placed in this district, and to which I referred last week, will provide about three weeks' work, the plants to benefit being at Rotherham, Stocksbridge and Penistone. Further railway work has been placed for the Colonies, but Sheffield and district firms do not figure as direct recipients. One of the concerns to benefit, however, has a working arrangement with a Sheffield firm, and part of the contract may be carried out here. The private wagon trade remains almost lifeless, only a small amount of steel is being sent to the shipbuilding centres; and colliery engineering requirements, apart from one or two specialised lines, are being met very sparingly.

Lighter Steel Trades.

Departments producing steel goods of a lighter nature are in a much more flourishing condition than those which specialise in heavy material. Several branches of industry in other parts of the country are buying large quantities of steel parts and tools, and a number of local finishing trades are getting busier. In particular one notices the motor car industry, which for a long time has been a good customer of Sheffield, and with developments in favour of pressed all-steel bodies additional work of a substantial character should be forthcoming from this source in the near future. It is interesting to note that more than half of the £366,000 worth of steel exported to the United States from Sheffield last year consisted of cold rolled strip for the manufacture of safety razor blades. These exports, by the way, recorded an increase in value of £60,000 on the figures for the previous year. The tool trade is doing well, and the year promises to be a busy one, particularly for export. In view of the great amount of foreign trade that Sheffield has lost since the war owing to the economic advantages that have accrued to our competitors this prospect of a return of some of Sheffield's old customers is particularly gratifying. The fact is that foreign-made tools, especially those which are subjected to very great strain and wear, are very inferior to the Sheffield product, and the call to-day is for more and more efficient, well-hardened tools.

Inrush of Foreign Cutlery.

My reference last week to the German Government's protest at the promptitude with which the new duty on imported cutlery was imposed has an added significance in view of the returns for last month. Such an amazing quantity of cutlery was rushed into the country during that period that one can only agree that Mr. Godfrey Cheesman, the general secretary of the National Union of Manufacturers, was perfectly right in describing the German protest as amusing. The imports of foreign cutlery since the war have varied from about £30,000 to £50,000 per month. In November, when it was known that the duties were pending, the imports moved up to a value of £156,000, but last month the value was the staggering and unprecedented one of £650,000. This means, of course, that at the normal rate of consumption it will be somewhere about a year before these surplus stocks are exhausted and a corresponding lapse of time before Sheffield cutlery works can expect to derive any benefit from the tariff. This great inrush of imports in December and to a lesser degree in November, brings the total imports for the year in excess of the exports for the first time in history. It is possible, of course, that much of this cutlery got into the country before the tariff became operative will be retailed at the advanced prices, and already, it is reported, an order for £200 worth of razors has been placed in Sheffield by a buyer who formerly relied on the German market and who now finds that the German price, with the addition of the duty, equals that of the Sheffield product. The local cutlery and plate trades are only lightly employed at present, as is customary at this time of the year. The shop trade is poor, and the bulk of the work now in hand is for contracts for shipping companies and other concerns with large catering connections.

Nottinghamshire Coal Find.

Sinking at the new Blidworth Colliery, a few miles from Mansfield, has been rewarded by the striking of the top hard seam. The engineers were very near in their calculations, for they predicted when sinking began that the seam would be reached at the end of last year. There was, however, some upsetting of the calculation of the depth at which the seam would be found. This was anticipated at 630 yards, but the actual depth proves to be 721 yards. The failure to locate the seam had caused considerable anxiety, and there was a general feeling of relief in the district when the news became known that the top hard seam had been reached. The success was obtained in No. 2 shaft. The other one is now down to a depth of about 700 yards, so that it should only be a few weeks before the coal is reached there. At Rufford Colliery, which is less than two miles away, the bed was reached 167 yards nearer the surface, and this big difference in the two depths has been rather puzzling. Another curious fact is that the geological formations at Blidworth are different in many respects from those of other shafts in the locality. The colliery is being laid out for the production of between 3000 tons and 4000 tons a day. To get to the main seam the sinkers passed through the High Hazel seam, and this proved to be 3ft. 5½in. thick. The top hard is 3ft. 7½in. thick.

Other Colliery Topics.

A successful application was made to the Railway and Canal Commission Court by Pope and Pearson, the owners of Silkstone Collieries and Altofts—West Riding—for the right to work the Beeston—diamond—seam, which is under 45 acres at Colverly Green, Altofts. Application was also made for certain ancillary rights, including permission to let down the surface of the land on condition that they repaired any resulting damage. There are about 225,000 tons of coal under this area, and at present rates the value is £200,000. There was no opposition from the local authorities. Mr. Justice Sankey said that the Court was clearly of opinion that it was in the national interest for the application to be granted. Mr. Korthals-Altes, the distinguished Dutch engineer, who has been visiting the Doncaster coalfield in connection with the drainage problem there, aroused considerable interest by his statement that at Bentley Colliery it had been necessary to abandon the working of a pillar of coal covering 400 acres, and containing 10,000,000 tons, beneath the river Don. Inquiry into this point reveals the fact that the coal cannot be worked owing to the risk of subsidence taking place, and the owners must not interfere with this belt of coal, the value of which is estimated at £7,500,000. This drainage problem about which Mr. Korthals-Altes has been consulted, and with which I dealt in my letter some weeks ago, is described by him as a difficult one to solve. It is not only a matter of drainage, he says, but first a question as to whether drainage and navigation can be combined, and, secondly, a question of saving large quantities of coal which certainly will have to be abandoned near the river unless the problem is solved. He advocates a uniform general drainage Act for England.

Launch of Super-Trawler.

The Neptunia, the second largest French steel trawler, which has been launched from the Ouse shipbuilding yard at Selby, is being fitted with the latest radio apparatus, with a 3000-mile radius, so that she can keep in touch with her owners during her six weeks' journeys. She is 175ft. long, 29ft. broad, and has a steaming radius of 6000 miles without refuelling. Her bunkers carry 450 tons of coal, equal to twenty-one days' steaming at 12 knots. The trawler has a water ballast tank from midship to forepeak, such as is now being put in all the latest long-distance steam fishing trawlers, so that the captain can trim the ship at sea.

Hull Bridge Opponents.

Although Hull City Council's project to construct a new North Bridge over the river Hull, at a cost of £275,000 has been approved by a two-thirds majority at a town's meeting, opponents of the scheme have demanded a poll of the ratepayers, and it will be taken in the course of a week or two. The contention is that an alternative bridge, costing £61,000, would be adequate.

NORTH OF ENGLAND.

(From our own Correspondent.)

Pig Iron Famine.

WHAT is practically a famine exists in the Cleveland pig iron trade. There is scarcely any pig iron available in the district for anything like early delivery, and the chief producers are declining to book any more orders at present, so heavy are their commitments. There is no doubt that for all classes of iron, both foundry and hematite, the demand far outstrips the supply, and were the outlook in the coal trade clearer, so that ironmasters could feel secure against interruption of supplies in consequence of a stoppage at the mines in May next, and also against a possible further rise in fuel prices, more blast-furnaces would be lighted up. At the moment, however, ironmasters do not care to take the risk, and the result is that buyers are clamouring for iron, deliveries are in arrears, and ships requiring pig iron cargoes are either being delayed or dispatched with uncompleted quantities. One contributory factor which has tended to accentuate the shortage of pig iron has been the contraction in the supplies of continental iron offered. Last year imports of foreign iron were heavy, but very little is now on offer, and deliveries are still more uncertain. Those consumers who bought ahead have undoubtedly reason to be gratified with their position, for buyers are quite willing to pay the higher prices. Since last week prices have been advanced by 6d. per ton—making the third advance in a period of a little more than three weeks. The revised home prices are:—No. 1 Cleveland foundry iron, 72s.; No. 3 G.M.B., 69s. 6d.; No. 4 foundry, 68s. 6d.; No. 4 forge, 67s. 6d.; and mottled and white iron, 67s., a premium of 6d. per ton having to be added in the case of iron for export.

Hematite Pig Iron.

The East Coast hematite pig iron trade is also in a very strong position, and an indication that prices are expected to move upwards is the fact that makers are quoting as high as 80s. per ton for March delivery. Makers are so full up with orders that there is little iron available for market purposes this month, and quotations for February range from 77s. to 78s. per ton for mixed numbers, with No. 1 quality at a premium of 6d. per ton.

Ironmaking Materials.

Values of foreign ore are very strong, and although there is no news of any recent business, the price of best Bilbao Rubio is probably in the region of 21s. 6d. per ton c.i.f. Tees. Quotations for coke vary, but a fair average figure for good furnace qualities seems to be 22s. per ton, delivered at the works.

Manufactured Iron and Steel.

The position in the manufactured iron and steel trade has improved considerably since the beginning of the year. Manufacturers report a healthy trade, and prices are inclined to firmness. The heavy steel rail mills are very busy, and an enormous tonnage is now being turned out in this district. There is also a continued good demand for galvanised sheets, but specifications for shipbuilding material are still very few.

The Coal Trade.

Colliery fitters have every reason to be satisfied with the trade that has come forward since the beginning of the year. There has been a sustained demand and good buying and prices have appreciated a little. Of course, the subvention is a material factor in helping the pits to sell their product and in enabling idle collieries to resume operations, and without it the position must have been much different. Manufacturing fuel is in increasing request on home account, and export business shows a steady expansion. The outlook industrially is better, and it is having its proportionate beneficial effect, and it may also be that stocks are being laid in against eventualities should there be trouble in May. Unemployment among the miners in the last two years has been so severe that now that they are getting back to work again it is felt that the best efforts will be made to prevent anything in the nature of a national stoppage should such a disaster threaten when other of the big industries are showing signs of recovery. With producers of every description of coal now heavily booked for this month, and the majority of loading turns actually stemmed with named tonnage, the tone of the market for the remainder of the month is very strong. Buyers are still numerous, but in most cases they find that they cannot obtain definite deliveries, and consequently are having to postpone placing orders until February. Thus, while the January market delivery is a very strong one, the position for next month is rapidly

gaining substantial strength, and the outlook ahead is a cheery one for fitters of all-grade collieries. Best Northumberland steams continue to appreciate in value under the filling up of positions well ahead, and with a good inquiry moving 16s. is being realised. Other steams, as well, are ruling stronger, Tyne primes and similar good classes at 15s. 6d., and seconds at 15s. Steam smalls show no notable change from last week, and 10s. 3d. to 10s. 6d. still stands for specials, 9s. 6d. for bests, and 8s. 6d. for secondary makes. Supplies are small, and the tendency is favourable to sellers. There is good progress to report in the Durham section. A continued good demand is experienced to back up the already well-booked positions, and better prices are to be obtained. Gas coals lack supplies and the tone is stronger, if values are not much changed. Best qualities are generally at 16s. 9d., with specials about 17s. 6d. Coking coals are a steadier trade at 16s. for good unscreened sorts, and 15s. 6d. for ordinary brands. The shortage of coke supplies created by the already heavy volume of business arranged has the effect of accentuating the pressure for requirements, and sellers are enabled to obtain maximum values. Gas coke is in good demand at 24s. 6d. to 25s. 6d., with patent foundry makes at 22s. to 23s., and beehive sorts at 30s. to 32s.

SCOTLAND.

(From our own Correspondent.)

A Quiet Resumption.

THE scale of operations in the steel, iron and coal trades is now similar to that existing prior to the New Year holidays. Reports are to the effect that very little business has accumulated during the holidays, and that the general situation shows little change.

Prospects.

If recent pronouncements on the situation in the shipbuilding and the shipping trades may be taken as any criterion, the outlook for this year is no better, if not actually worse, than that of last year. Shipbuilders find it impossible to quote a price which would appeal to owners, while owners find difficulty in securing freights which would show even a small margin of profit. Foreign competition is rife, and the outlook most unsatisfactory. This lack of activity in shipbuilding has a direct effect on the steel, iron and coal industries in Scotland, more especially in the West Coast area. The situation at the Clyde yards is unprecedented for lack of business. Not a single liner is on the stocks, and the yards are very empty. A number of contracts have been announced recently, but some time must elapse before work can be commenced on them. In the meantime the local steel and iron works are poorly engaged.

Steel and Iron.

There has been no appreciable change in general conditions in the steel and iron trades. Markets are very slow, and there is no apparent improvement compared with the close of last year. All works have been restarted, with the exception of those in which repairs to machinery have not yet been completed. Few makers can see more than two weeks ahead, and the hand-to-mouth system of buying is likely to continue for some time to come. Apart from some orders for steel rails, there is nothing fresh to report. Plates and sections are very quiet, and the position of light black and galvanised sheets still provides the strong feature of the industry. The bar iron works are doing next to nothing in their iron departments, the bulk of the output being re-rolled steel bars. Pig iron lacks interest. Export is a shade better than home demands at present, but the total turnover is of small account.

Steel Prices.

In view of the fact that prices of steel ship plates and sections have fallen to a low level as the result of keen competition, it is proposed to re-establish the control system. If complete unanimity amongst makers could be secured, fixed minimum prices would again be agreed upon.

Coal.

Many of the collieries continue in a strong position despite the scarcity of fresh business on foreign account. Outputs of splints, ells and best Fifeshire steams are fully booked to the end of this month at any rate, and it would be difficult to secure small supplies even through second hands. Foreign demands have fallen off, owing partly to the firmer prices quoted; but until the business on hand has been disposed of, cheaper quotations are unlikely. Lothians steams are not so well booked as round coal in the West of Scotland and Fifeshire, and business can be done at moderate prices. Washed materials are not so firm as round fuels, but maintain their recent position. Supplies for home consumption are ample. Aggregate shipments amounted to 260,403 tons, against 143,613 tons in the preceding week and 176,631 tons in the same week last year.

WALES AND ADJOINING COUNTIES.

(From our own Correspondent.)

Coal Trade Conditions.

THE position in the steam coal trade continues to afford some satisfaction, inasmuch as fairly busy conditions prevail. The docks are well supplied with tonnage and loading operations are active, which means that the bulk of the collieries, at any rate, are well employed. The improvement in the situation may to some extent be gauged from the fact that at the commencement of this week there were fourteen steamers waiting to get into berths. The leading coals are very fully stemmed for the remainder of the month, and prices of both large and small coals hold very steady, notwithstanding the fact that the fresh inquiry coming in is not what may be described as extensive. Chief interest, however, has been centred in the revival in the demand from America for anthracite qualities and dry sized coals. The failure last week of the coal conference to settle the strike prevailing in the American anthracite coalfield resulted in a stronger inquiry for coals from this district, and it is reported that the bulk of the output of several of the leading anthracite undertakings has been booked up for a month or so. Certainly, there was a spurt in the chartering of tonnage for the Northern Range of ports, and with rates for South American destinations very firm on account of the depressed homeward market, freights appreciated substantially for the Northern Range, and rose from 7s. 6d. to as much as 10s. 6d. Tonnage amounting to round about 50,000 to 60,000 tons has been taken up within the past week, and there is still a steady demand for steamers to sail at the end of this month and during the early part of February.

Colliery Deals.

Reference was made last week to the prospective transfer of the New Brook Colliery to the Pwllbach, Tirbach and Brynamman Anthracite Collieries, Ltd. It is now officially stated that the sale has been completed, the price being in the neighbourhood of £40,000. Another colliery deal is also reported, this being the Trimsaran collieries in the Gwendraeth Valley anthracite area. It is not long ago that this property was sold by the late Mr. Evan Jones to the Ashburnham Collieries, Ltd., at the head of which is Sir Beddoe Rees. It is now understood that the property has been transferred to the United Anthracite Combine, at a price of round about £150,000.

Traffic Returns.

A statement has just been issued by the Great Western Railway Company relating to the traffic during 1925 at the docks in South Wales under its control, viz., Cardiff, Swansea, Newport, Barry, Port Talbot, and Penarth. The figures are far from encouraging, as the fall in trade revealed is very considerable. Taking the import and export trade together, the decline, as compared with 1924, amounts to 5,311,878 tons, and when set against the figures for 1913 the reduction is no less than 12,068,000 tons, equal to a million tons a month. Imports last year fell away as compared with the previous year by 688,029 tons, while exports were down 4,613,849 tons. Coal and coke exports suffered relatively the most, as the falling off amounted to 4,809,403 tons, while tin-plates were less by 85,000 tons, and grain and flour by 12,000 tons; but, on the other hand, there were some gains, as patent fuel improved by 56,517 tons, oil exports advanced by 95,000 tons, general merchandise by 94,000 tons, cement by 26,000 tons, and iron and steel rails and ironwork were higher by 22,000 tons. It naturally follows that with the coal trade so depressed last year there was not the demand for mining timber, and the returns show that the imports of pitwood and mining timber were 191,913 tons less than in 1924, while iron ore imports were down by 299,800 tons.

Steel Trade Developments.

An interesting development at Llanelly is the decision of the Llanelly Steel Company, Ltd., to set up new works on a site adjoining its existing steel works. This new enterprise is to take the form of a sheet mill and galvanising works, comprising six mills. The erection of new works is to be proceeded with at once, and the latest type of machinery is to be installed. It is estimated that when the works are completed employment for several hundred men will be available. The Joint Standing Committee of the Siemens Steel Trade Conciliation Board met at Swansea on Friday last, when a number of claims involving increases in costs were considered, including one for a minimum wage of 55s. per week for the lower-paid men. The majority of the claims were declined on account of the depressed state of the industry, but it was agreed that the anticipated fall in the sliding scale ascertainment for the three months ended December 31st last should not come into operation, but that the workmen should continue to receive the present 20 per cent. under the sliding scale arrangement, plus all existing bonuses, for a further three months.

Dry Dock Developments.

Bailey, Graham and Co., Ltd., have recently effected at Newport a concentration of their works by the removal of their engineering plant at the Tyne Engine Works, Mill-parade, to their new dry dock premises at Newport docks. The old Tyne Engine Works at Mill-parade had outgrown their usefulness, and the concentration of the company's engineering plant at its dry dock premises was part of the original scheme when the dry dock was constructed at Newport. Following upon the amalgamation of the Mountstuart Dry Docks and Shearmans, Ltd., with Elliot and Jeffery, Ltd., it is reported that several well-known Cardiff docksmen are purchasing the premises originally known as Mordey, Carney's Town Dock Works, Newport, which were recently closed down by Mountstuart Dry Docks and Shearmans, Ltd., as the result of the depression in the ship-repairing and engineering industry. The works have three dry docks, and it is understood that the management will probably be placed in the hands of Mr. John Blain Hunt, of Cardiff.

Current Business.

The tone of the steam coal market maintains steadiness for practically all descriptions, with the possible exception of dry large qualities. The bulk of undertakings are comfortably stemmed for the next week or two, and with adequate supplies of tonnage to hand they are able to command their prices for any quantities that are required for anything like early shipment, which is in marked contrast to the conditions of a week or so ago, when they were compelled to make concessions to those buyers who were able to take coals for quick shipment. Both large and small coals are well sold. In the case of anthracite the market is firm, especially for sized descriptions. Loading pressure at Swansea and Port Talbot is heavy.

CALENDARS, DIARIES, &c.

KENRICK AND JEFFERSON, Ltd.—Calendar for 1926–1927. Desk calendar with daily tear-off sheets.

EDWARD WOOD AND CO., Ltd., Manchester.—Pocket diary for 1926. Wall calendar with monthly tear-off sheets.

"THE BUILDER."—Calendar for 1926. A view of the new Bank of England showing its relation to its surroundings.

THE STANTON IRONWORKS COMPANY, Ltd., near Nottingham. —Pocket diary, which contains much useful information.

ENGINEERING AND COMMERCIAL COPYING COMPANY, 137, Victoria-street, S.W. 1.—Wall calendar with monthly tear-off sheets.

URQUHART, LINDSAY AND ROBERTSON ORCHAR, Ltd., Blackness Foundry, Dundee.—Wall calendar with monthly tear-off sheets.

PECKETT AND SONS, Ltd., Bristol.—Wall calendar with monthly tear-off sheets. One of the firm's tank locomotives is shown in colour.

WELIN DAVIT AND ENGINEERING COMPANY, Ltd., 5, Lloyd's avenue, E.C. 3.—Desk calendar with pictures of the many applications of the Welin davit to ships.

COUNTY OF LONDON ELECTRIC SUPPLY COMPANY, Ltd. Moorgate-court, Moorgate-place, E.C. 2.—Telephone card surmounted by a coloured picture of Barking power station.

THE D.P. BATTERY COMPANY, Ltd., Bakewell, Derbyshire.—Wall calendar with monthly tear-off sheets. A coloured print is given of "The Valley of the Dove," near Crowdicotes, Derbyshire.

CATALOGUES.

THE BUTLER MACHINE TOOL COMPANY, Ltd., Victoria Ironworks, Halifax.—Catalogue No. 4, describing the "Butler" puncher type slotting machines.

SIEMENS BROTHERS AND CO., Ltd., Woolwich, S.E. 18.—Pamphlet 820A, containing particulars of the thermo-electric pyrometer made by the company.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, East Pittsburgh, Pa., U.S.A.—Motor application circular 7378, entitled "Materials Handling."

MANLOVE, ALLIOTT AND CO., Ltd., Nottingham.—Circular 752B, describing steam-heated rotary drying machines of the unjacketed, jacketed and central drum types.

FESCOL LIMITED, Penarth-street, Canterbury-road, S.E. 15.—Brochure illustrating and describing methods of repairing worn parts of motor vehicles by the "Fescol" process.

THE CASSEL CYANIDE COMPANY, Ltd., 19, St. Vincent-place, Glasgow.—Booklet entitled "A Treatise on Case Hardening and the Heat Treatment of Steel by Sodium Cyanide."

JOHNSON, HURLEY AND MARTIN, Ltd., Gosford-street, Coventry.—Leaflet describing the firm's 9 horse-power and 11 horse-power petrol engines for industrial purposes.

GLENIFFER MOTORS, Ltd., Temple Works, Anniesland, Glasgow, W. 2.—Descriptive catalogue of the Model M and K engines covering a range of 28 to 105 horse-power.

STERNS, Ltd., Royal London House, Finsbury-square, E.C. 2. —Two booklets entitled "Lubrication of the Commercial Motor" and "The Lubrication of the Steam Wagon"

A. ROSS, HOTCHKISS AND CO., Ltd., 1, Glengall-road, S.E. 15. Booklet entitled "Notes on Circulation: Nature's Economical Method Applied to Commercial Operations," by A. Ross.

THE MARCONIPHONE COMPANY, Ltd., 210–212, Tottenham Court-road, W. 1.—Publication No. 364F, describing Marconiphone and Stirling radio receivers, accessories and components.

THE RANSOME MACHINERY COMPANY (1920), Ltd., 46, Victoria-street, S.W. 1.—Book No. 40, illustrating and describing featherweight, lightweight and welterweight concrete mixers.

THE ENGLISH ELECTRIC COMPANY, Ltd., Queen's House, Kingsway, W.C. 2.—Publication No. 571A, dealing with a two-cylinder, 20,000-kilowatt, 3000 revolutions per minute steam turbine.

THE MARCONIPHONE COMPANY, Ltd., 210–212, Tottenham Court-road, W. 1.—Publication No. 437, describing the "Marconiphone" Type 21 receiver and the Sterling "Dinkie" loud speaker.

CONTRACTS.

THE BUENOS AYRES AND PACIFIC RAILWAY COMPANY, Ltd., has just placed a contract with British manufacturers for 44,000 tons of steel rails.

THE BRITISH THOMSON-HOUSTON COMPANY, Ltd., has been successful in obtaining a twelve months' contract for the supply of Mazda lamps to the Great Southern Railway Company (Ireland).

THE Belgian Posts and Telegraph Department has placed an order with Ateliers de Constructions Electriques de Charleroi for the manufacture, laying and jointing of 350 kilomas.—about 218 miles—of special long-distance telephone cable for connecting Brussels with La Panne, Lille and Roosendaal, at a total cost of a little over £600,000.

THE RILEY STOKER COMPANY, Ltd., Palace Chambers, Bridge-street, London, S.W. 1, has just received an order for eight Riley Super stokers, each to burn up to 10 tons of coal hourly, for eight Babcock boilers, each for normal duty, 134,000 lb. actual steam hourly, and for 156,000 lb. overload. This is a repeat order from a central station already having thirteen Riley stokers.

THE INSTITUTION OF FUEL ECONOMY ENGINEERS.—The first Council meeting of the new Institution of Fuel Economy Engineers was held in London at the Engineers' Club on Friday, January 15th, when the first list of members was submitted for approval of the Council. These applications came from leading engineers associated with a wide selection of industries throughout the country, showing the great interest which this new institution has aroused, and fully confirming the beliefs of the founders that an institution of fuel technologists was necessary for the scientific development of our fuel resources. The Council has decided, in view of the enthusiastic support which is forthcoming, to make immediate arrangements to open a London office, and in the meantime applications should be addressed to the Secretary, Mr. H. L. Pirie, 29, Sherwin road, Lenton, Nottingham.

Current Prices for Metals and Fuels.

IRON ORE.

N.W. COAST—	
Native	21/-
(1) Spanish	18/6
(1)N. African	18/6
N.E. COAST—	
Native	—
Foreign (c.i.f.)	21/6

PIG IRON.

	Home. £ s. d.	Export. £ s. d.
(2) SCOTLAND—		
Hematite	3 17 6	—
No. 1 Foundry	3 19 0 to 4 1 6	
No. 3 Foundry	3 16 6 to 3 19 0	
N.E. COAST—		
Hematite Mixed Nos.	3 17 6	3 17 6
No. 1	3 18 0	3 18 0
Cleveland—		
No. 1	3 12 6	3 13 0
Silicious Iron	3 12 6	3 13 0
No. 3 G.M.B.	3 10 0	3 10 6
No. 4 Foundry	3 9 0	3 9 6
No. 4 Forge	3 8 6	3 9 0
Mottled	3 7 6	3 8 0
White	3 7 6	3 8 0
MIDLANDS—		
(3) Staffs.—		
All-mine (Cold Blast)	10 10 0	—
North Staffs. Forge	3 17 6	—
,, ,, Foundry	4 7 6	—
(3) Northampton—		
Foundry No. 3	3 4 0	—
,, Forge	2 16 0 to 2 17 0	
(3) Derbyshire—		
No. 3 Foundry	3 7 0	—
Forge	3 2 6 to 3 3 0	
(3) Lincolnshire—		
No. 3 Foundry	3 8 0	—
No. 4 Forge	3 5 6	—
Basic	3 6 0	—
(4) N.W. COAST—		
N. Lancs. and Cum.—		
Hematite Mixed Nos.	4 10 0 (a) / 4 12 6 (b) / 4 17 6 (c)	—

MANUFACTURED IRON.

	Home. £ s. d.	Export. £ s. d.
SCOTLAND—		
Crown Bars	11 5 0	—
Best	—	—
N.E. COAST—		
Common Bars	11 0 0	—
LANCS.—		
Crown Bars	11 10 0	—
Second Quality Bars	11 0 0	—
Hoops	15 0 0	14 15 0
S. YORKS.—		
Crown Bars	12 10 0	—
Best ,,	13 10 0	—
Hoops	14 10 0	—
MIDLANDS—		
Crown Bars	11 5 0 to 12 0 0	
Marked Bars (Staffs.)	14 0 0	—
Nut and Bolt Bars	10 5 0 to 11 0 0	
Gas Tube Strip	12 5 0 to 12 10 0	

STEEL.

	(6) Home. £ s. d.	(7) Export. £ s. d.
(5) SCOTLAND—		
Boiler Plates	11 0 0	—
Ship Plates, ¾in. and up.	7 10 0 to 7 12 6	
Sections	7 0 0 to 7 2 6	
Steel Sheets, under 3/16in. to ¼in.	9 0 0 to 9 2 6	
Sheets (Gal. Cor. 24 B.G.)	—	£17 to £18

STEEL (*continued*).

	Home. £ s. d.	Export. £ s. d.
N.E. COAST—		
Ship Plates	7 7 6	—
Angles	7 0 0	—
Boiler Plates	11 10 0	—
Joists	7 0 0	—
Heavy Rails	8 0 0	—
Fish-plates	12 0 0	—
Channels	10 5 0	£9 to £9 5
Hard Billets	8 2 6	—
Soft Billets	7 5 0	—
N.W. COAST—		
BARROW—		
Heavy Rails	8 0 0†	—
Light ,,	8 5 0 to 8 10 0	
Billets	7 10 0 to 9 0 0†	
MANCHESTER—		
Bars (Round)	8 5 0 to 8 10 0	
,, (others)	8 0 0 to 8 5 0	
Hoops (Best)	15 5 0	15 0 0
,, (Soft Steel)	13 15 0	13 10 0
Plates	7 17 6 to 8 5 0	
,, (Lancs. Boiler)	11 10 0	—
SHEFFIELD—		
Siemens Acid Billets	10 10 0	—
Bessemer Billets	11 5 0	—
Hard Basic	8 12 6	—
Intermediate Basic	8 2 6	—
Soft Basic	7 5 0	—
Hoops	12 0 0	—
Soft Wire Rods	9 10 0	—
MIDLANDS—		
Small Rolled Bars	7 17 6 to 8 0 0	
Billets and Sheet Bars	6 2 0 to 6 10 0	
Sheets (20 W.G.)	11 10 0 to 12 0 0	
Galv. Sheets, f.o.b. L'pool	16 10 0 to 16 15 0	
Angles	7 2 6 to 7 5 0	
Joists	7 2 6 to 7 5 0	
Tees	8 2 6 to 8 5 0	
Bridge and Tank Plates	7 15 0 to 8 0 0	
Boiler Plates	11 0 0 to 12 0 0	

NON-FERROUS METALS.

SWANSEA—	
Tin-plates, I.C., 20 by 14	19/3 to 19/6
Block Tin (cash)	279 5 0
,, (three months)	273 10 0
Copper (cash)	58 15 0
,, (three months)	59 17 6
Spanish Lead (cash)	34 8 9
,, (three months)	34 7 6
Spelter (cash)	37 12 6
,, (three months)	37 0 0
MANCHESTER—	
Copper, Best Selected Ingots	65 10 0
,, Electrolytic	66 10 0
,, Strong Sheets	90 0 0
,, Tubes (Basis Price)	0 1 1
Brass Tubes (Basis Price)	0 1 0
,, Condenser	0 1 2¼
Lead, English	37 0 0
,, Foreign	36 0 0

FERRO ALLOYS.

(*All prices now nominal.*)

	Per Ton.	Per Unit.
Tungsten Metal Powder	2/1 per lb.	
Ferro Tungsten	1/10 per lb.	
Ferro Chrome, 4 p.c. to 6 p.c. carbon	£23 10 0	8/-
,, 6 p.c. to 8 p.c. ,,	£23 0 0	7/6
,, 8 p.c. to 10 p.c. ,,	£22 7 6	7/-
,, Specially Refined		
,, Max. 2 p.c. carbon	£40 10 0	14/-
,, ,, 1 p.c. ,,	£49 0 0	16/-
,, ,, 0·70 p.c. carbon	£56 0 0	17/6
,, ,, carbon free	1/5 per lb.	
Metallic Chromium	3/6 per lb.	
Ferro Manganese (per ton)	£15 for home, £15 for export	
,, Silicon, 45 p.c. to 50 p.c.	£11 15 0 scale 5/- per unit	
,, ,, 75 p.c.	£21 10 0 scale 6/- per unit	
,, Vanadium	15/3 per lb.	
,, Molybdenum	6/1 per lb.	
,, Titanium (carbon free)	1/1 per lb.	
Nickel (per ton)	£172 to £177	
Cobalt	10/- per lb.	
Aluminium (per ton)	£120	

FUELS.

SCOTLAND.

	Export.
LANARKSHIRE—	
(f.o.b. Glasgow)—Steam	16/6
,, ,, Ell	17/6
,, ,, Splint	19/- to 21/-
,, ,, Trebles	18/-
,, ,, Doubles	17/-
,, ,, Singles	14/9
AYRSHIRE—	
(f.o.b. Ports)—Steam	15/6
,, ,, Jewel	17/3
,, ,, Trebles	17/9
FIFESHIRE—	
(f.o.b. Methil or Burntisland)—Steam	13/3 to 16/-
Screened Navigation	21/6
Trebles	18/6 to 19/6
Doubles	16/10½
Singles	15/-
LOTHIANS—	
(f.o.b. Leith)—Best Steam	15/6
Secondary Steam	14/10½
Trebles	18/-
Doubles	16/9
Singles	14/9

ENGLAND.

(8) N.W. COAST—	
Steams	23/6
Household	40/- to 45/-
Coke	27/-
NORTHUMBERLAND—	
Best Steams	16/3 to 16/6
Second Steams	15/-
Steam Smalls	9/9 to 10/-
Unscreened	14/-
Household	20/- to 22/-
DURHAM—	
Best Gas	16/9
Second	16/-
Household	20/- to 22/-
Foundry Coke	22/- to 24/-
SHEFFIELD—	Inland.
Best Hand-picked Branch	34/ to 34/-
Barnsley Best Silkstone	28/- to 30/- —
Derbyshire Best Brights	26/- to 27/6 —
,, ,, House	24/- to 25/- —
,, ,, Large Nuts	17/- to 20/- —
,, ,, Small	12/6 to 14/- —
Yorkshire Hards	17/- to 19/6 —
Derbyshire ,,	16/- to 19/- —
Rough Slacks	10/- to 12/6 —
Nutty ,,	7/6 to 9/- —
Smalls	3/6 to 6/- —
Blast-furnace Coke (Inland)*	— —
,, ,, (Export)	f.o.b. 19/3 to 19/9

(9) SOUTH WALES.

CARDIFF—	
Steam Coals:	
Best Smokeless Large	22/6 to 23/-
Second ,, ,,	21/6 to 22/-
Best Dry Large	21/- to 21/6
Ordinary Dry Large	20/6 to 21/-
Best Black Vein Large	20/- to 20/6
Western Valley Large	19/- to 20/-
Best Eastern Valley Large	19/- to 19/6
Ordinary ,, ,,	18/9 to 19/-
Best Steam Smalls	12/6 to 13/-
Ordinary ,,	10/- to 12/-
Washed Nuts	19/- to 28/6
No. 3 Rhondda Large	27/- to 27/6
,, ,, Smalls	17/- to 18/-
No. 2 ,, Large	17/6 to 18/-
,, ,, Through	16/- to 17/-
,, ,, Smalls	10/6 to 11/-
Foundry Coke (export)	37/6 to 40/-
Furnace Coke (export)	25/- to 30/-
Patent Fuel	20/- to 22/6
Pitwood (ex ship)	24/- to 24/6
SWANSEA—	
Anthracite Coals:	
Best Big Vein Large	41/6 to 42/6
Seconds	32/6 to 37/6
Red Vein	28/- to 31/-
Machine-made Cobbles	52/6 to 55/-
Nuts	55/- to 57/6
Beans	42/6 to 45/-
Peas	21/- to 24/-
Breaker Duff	8/6 to 8/9
Rubbly Culm	10/- to 10/6
Steam Coals:	
Large	22/- to 23/6
Seconds	20/- to 22/-
Smalls	9/- to 10/-
Cargo Through	16/6 to 18/-

(1) Delivered. (2) Net Makers' works. (3) f.o.t. Makers' works, approximate. (4) Delivered Sheffield. (5) Glasgow, Lanarkshire, and Ayrshire.
(6) Home Prices—All delivered Glasgow Station. Boiler Plates 10/- extra delivered England. (7) Export Prices—f.o.b. Glasgow. (8) Except where otherwise indicated, coals are per ton at pit for inland and f.o.b. for export, and coke is per ton on rail at ovens and f.o.b. for export. (9) Per ton f.o.b. * For blast-furnaces only, 17/-, with fluctuations according to analysis; open market, 17/6 to 19/- at ovens. † Latest quotations available. (a) Delivered Glasgow, (b) Delivered Sheffield. (c) Delivered Birmingham.

French Engineering Notes.

(From our Correspondent in Paris.)

Advancing Costs.

A FURTHER hardening of rolled iron and steel prices is foreshadowed by the increasing cost of coke and pig iron. Coke was again advanced at the beginning of this month and prices will probably be further increased in March next. Blast-furnace proprietors have put up their quotations to a level which is giving rise to strong protest from pig iron consumers, who complain that the quotations are much higher than are justified by the coke prices. At the same time, the new quotations are accompanied by an offer to supply all the pig iron that may be needed instead of the supplies being limited as they are at present, much to the inconvenience of founders, who often find themselves in difficulties over deliveries to their customers. As a matter of fact, blast-furnace proprietors are encouraged to send as large a proportion as possible of their pig iron abroad on account of the higher prices obtainable, and apparently, if home consumers are to procure all they need, they must pay something approximating to those prices. In addition to the dearer raw material, manufacturers are feeling the pinch of the higher railway rates.

Scrap Iron.

Until the Government limited the exportation of scrap iron the country was being depleted of supplies which were sent to Italy and other countries, where the national resources in raw material are insufficient for the needs of the iron and steel industries. Since the exportation was limited to 120,000 tons a year, there has been trouble over the conditions under which the scrap iron is to be distributed, and after long negotiations between the Government and the various interested groups, it has been decided to entrust the exportation to two Comptoirs, one under the direction of the Comité des Forges, which will exercise control over the scrap from blooms, billets, and new pig iron, and another under the direction of a committee of dealers in iron, steel and old pig iron scrap. Every three months the French Government will issue licenses to foreign Governments for the maximum quantity of scrap allotted to them if required, and each Government will allocate quantities to manufacturers. This is done at the instance of the Italian Government, which found that private firms were monopolising the supplies of French iron and steel scrap to the detriment of the factories working for the State.

Shipbuilding.

The situation of the shipyards is so precarious that some builders are considering the advisability of taking up other classes of work, and on the occasion of the launching of a new South American liner at St. Nazaire, the Ateliers et Chantiers de la Loire officially opened an aircraft factory, which has been laid out in their shipyard. At present the aircraft industry is almost entirely centred around Paris, which is regarded as a serious inconvenience from the point of view of national defence, and the Government is therefore encouraging the decentralisation of the industry, such as is being done by the Chantiers de la Loire. The liner referred to is the Florida, of 13,600 tons displacement. The two groups of turbines develop 7000 horsepower, and the speed will be 17 knots. The only orders recently distributed are one for four torpedo boats of 1400 tons, under the programme of 1925, and another from Greece for four submarines of 730 tons, with Diesel engines. The facilities that have been offered to shipbuilders in the way of reducing the price of ship plates to enable them to compete for foreign orders have not, so far, met with any striking success.

An Alpine Railway.

The railway being constructed between Gap and La Mure is of particular interest from the fact that it is not only a great engineering feat, but will have the distinction of being worked with direct current at 2400 volts. Begun in 1910, the work was suspended during the war, but is now being rapidly pushed forward. Running through the Alps in the Dauphine, the railway necessitates the construction of a number of viaducts, some of them of a particularly important character. Between La Mure and Pont du Prêtre a viaduct across the Roizonne has a length of 225 m. and a height above the torrent of 101 m. All the viaducts are completed except two. The railway reaches its highest point at the Col de Manse, which is 1272 m.—4173ft.—above the sea level, and then descends to Gap at an altitude of 740 m. The energy for working the line will be provided by two stations, one on the Bonne and the other on the Drac. The latter station will be installed near Corps, where the river passes through a narrow gorge, and at this point a barrage, known as the Sautet, which is to have a height of 129 m.—423ft.—will be constructed. This barrage, the highest of its kind, will create a lake of 870 acres, and will supply energy not only for the railway but also for industrial purposes over a large area.

Power Alcohol.

The problem of producing power alcohol in the Colonies has taken another step in advance by the introduction of a Bill into Parliament authorising the Office National des Combustibles Liquides to investigate the means of creating an alcohol industry on a sound basis. It will be required first of all to propose regulations favouring the production of power alcohol in Africa, and when that is done it is hoped to establish an industry which will eventually supply a large proportion of the national needs for motor spirit. Meanwhile, the Comité Scientifique du Pétrole has decided to make a complete report upon the French resources in alcohol producing plants, and in view of the comprehensive character of the programme being prepared it is possible that something will be done in the way of supplying adequate quantities of alcohol at a price which will enable it to compete with petrol, the cost of which is advancing at a rate that threatens to make it almost prohibitive.

British Patent Specifications.

When an invention is communicated from abroad the name and address of the communicator are printed in italics.

When an abridgment is not illustrated the Specification is without drawings.

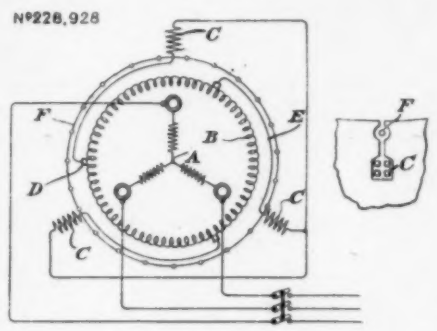
Copies of Specifications may be obtained at the Patent Office, Sale Branch, 25, Southampton-buildings, Chancery-lane, W.C., at 1s. each.

The date first given is the date of application; the second date, at the end of the abridgment, is the date of the acceptance of the complete Specification.

DYNAMOS AND MOTORS.

228,928. February 6th, 1925.—IMPROVEMENTS IN AND RELATING TO INDUCTION MOTORS, The British Thomson-Houston Company, Ltd., of Crown House, Aldwych, W.C. 2.

The induction motor described in this specification operates at unity power factor, and the object of the invention is to improve the starting characteristics of such motors. The motor has a polyphase primary winding A and a commutator exciting winding B, each wound on the rotor. The secondary winding C is placed on the stator and is connected with the commutator winding B through brushes D and leads E. The primary winding A is connected to a source of alternating current through a switch. A squirrel-cage winding F is provided for the purpose of giving the motor a high starting torque, the resistance of this winding being so chosen as to give the most desirable starting characteristic. The winding F is preferably placed in peripheral slots near the

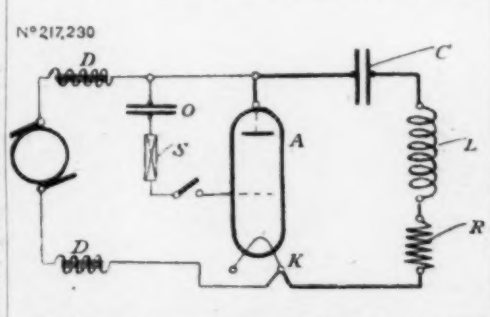


air gap of the machine, while the secondary winding C is placed in deeply embedded slots, the slots being interconnected by an air gap. This loose magnetic coupling between the windings F and C gives great leakage flux between the two windings and facilitates the starting of the motor owing to the fact that at starting most of the induced current is forced through the squirrel-cage winding. By this arrangement increased starting torque and lower starting current can be obtained, and when the motor is operated at substantially synchronous speed the current will flow mainly through the winding C owing to the higher resistance of the winding F. The interaction of the windings C and F at starting and at normal speed is very similar to the relation between two squirrel-cage windings as arranged in the well-known double squirrel-cage induction motor. The winding C can carry the exciting current just as it would if the squirrel-cage were not used.—*December 17th*, 1925.

TELEGRAPHS AND TELEPHONES.

217,230. June 5th, 1924.—IMPROVEMENTS IN AND RELATING TO ELECTRIC DISCHARGE DEVICES AND THERMIONIC TUBES AND THE LIKE, Dr. Erich F. Huth, of Wilhelmstrasse 130, Berlin, Germany.

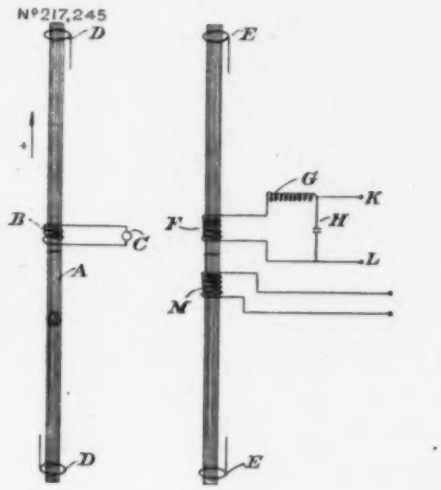
This invention relates to electric discharge devices operating by the ionisation of a gas or by thermionic or electron discharges and comprises one or more liquid or solid cathodes emitting rays, ions or electrons. The specification is a long one and describes a good deal of experimental work, and apparently the inventor claims to have discovered a new effect. A sudden drop of a discontinuous character is produced in the resistance of the path of discharge of a valve by first applying a high voltage to the



grid and then removing it, the voltage being such that the auxiliary electrode is positive with respect to the cathode. The high voltage is applied by bridging over a portion of the path of discharge. The expression "applying a high voltage to the grid and then removing it" is not intended to cover the application of an oscillatory potential to the grid. The diagram shows a method of producing electrical oscillations in accordance with the invention. The discharge path K A is connected to an oscillatory circuit C L R and the grid is connected to the anode through a resistance S and condenser O, choke coils D being included in the supply circuit. The high voltage may be applied to the auxiliary electrode automatically, periodically or regularly by substituting for the switch shown any known form of rotary switch or interrupter. The rotary switch may comprise, say, 100 contacts and be operated at a speed of 6000 revolutions per minute, whereby a high periodicity of about 10,000 periods per second is produced. The theory which the inventor sets forth is too long to be given here.—*December 7th*, 1925.

217,245. June 6th, 1923.—IMPROVEMENTS IN OR RELATING TO SYSTEMS FOR THE PROPAGATION AND RECEPTION OF HERTZIAN WAVES, Lucien Levoy, of 66, Rue de l'Université, Paris.

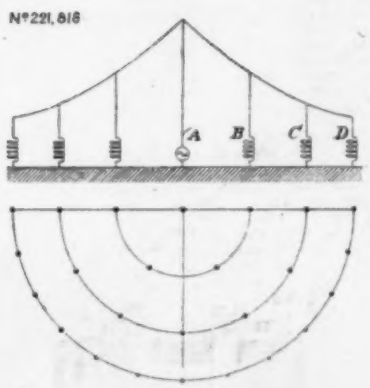
This invention is somewhat interesting. The inventor, who, we believe, was the originator of the supersonic heterodyne system of reception, describes an improved system for the propagation and reception of Hertzian waves in which the magnetic component of the waves is utilised instead of the electrostatic component. Nowadays the aerials used consist of wires stretched in space. On account of the fact, however, that the specific dielectric capacity of air is unity and its magnetic susceptibility is also unity, the magnitude of the aerials used has to be in the neighbourhood of the waves given out. This difficulty is, however, obviated by the use of aerials of the frame type. According to this invention the aerial has an iron core around which there are short-circuited coils, and part or the whole of the magnetic circuit may be surrounded by a fixed or movable conducting tube. Capacities and inductances may also be mounted between the short-circuited coils so that the system will operate as a wave filter. With this arrangement intense magnetic waves can be generated in the aerials, irrespective of whether they



are of the frame or elevated type. The left-hand illustration shows a magnetic radiating aerial composed of a magnetic substance A with a coil B energised with high-frequency alternating current supplied by a generator C. The movable short-circuited turns D, which can be displaced along the magnetic aerial, allow the position of the node of the longitudinal magnetic field to be varied and thereby the frequency at which the magnetic aerial oscillates. The right-hand illustration shows a magnetic reception aerial with short-circuited turns E for adjustment purposes and a reception winding F connected to the tuning circuit G and H. It is found that the potential at the terminals K and L is amplified. The winding M may be connected to circuits which are the seat of amplified currents so as to compensate the magnetic loss. There are four other illustrations.—*December 7th*, 1925.

221,818. September 11th, 1924.—A MULTIPLE AERIAL FOR WIRELESS SIGNALLING SYSTEMS, C. Lorenz Aktiengesellschaft, of Lorenzweg, Berlin-Tempelhof, Germany.

The object of this invention is to increase the radiating power of aerials. The aerial illustrated comprises a central conductor A fed by the high-frequency source and surrounded by a series of concentric rows of earthed conductors B C D, all provided with tuning means, and united at their upper ends. The height of the conductors decreases outwards, and as the density of the electric field generated by them decreases correspondingly the rows B C D must be arranged closer together; also the tuning of row B, for example, must be effected in such a way that reflection of energy shall take place by interaction with row C. In other words, no lines of electric strain and consequently no displacement currents, forming, with their corresponding currents



in the conductors, circuits closed upon themselves, shall be allowed to exist between the conductors, the lines of force starting from one conductor being completely opposed by those starting from the conductors opposite to it and thereby being forced outside the aerial structure. The same holds for the other conductors. As the conductor A has the smallest capacity, the wattless or idle current will be the smallest here. The conductor A carries practically only the whole watt current, and as a result the whole transmitter apparatus may be made smaller. As the distance of the upper part of row D from the earth is smaller than, for instance, that of row B, there is risk that considerably more lines of electric strain will go from D to earth between C and D. For that reason the distance between rows C and D and between the single wires of D must be made smaller than in the middle of the structure.—*December 11th*, 1925.

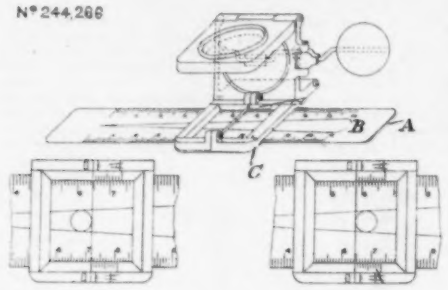
MEASURING AND TESTING INSTRUMENTS.

244,266. December 15th, 1924.—MEASURING LINEAR DIMENSIONS, A. L. Haas, India Store Depôt, Belvedere-road, Lambeth, London, S.E. 1.

The object of this invention is to provide a simple means of refined measurement particularly applicable to ball hardness indentations, although the apparatus may be applied to any measurements on a plane surface. It comprises a transparent rule A on which there is engraved a pair of inclined lines B B. A vernier C with a cross line slides on the rule and is read in conjunction with divisions on the rule. In use the apparatus is placed over the plane figure such as a circle or ball hardness

indentation it is desired to measure. The scale and cursor are then manipulated by sliding so that the mutually inclined lines on the scale and the transverse line on the cursor are set

N°244,266



tangential to the circle. The size of the circle so shrouded or enclosed is measured by the divided scale edge in conjunction with the vernier.—*December 17th*, 1925.

244,380. September 17th, 1925.—SPIRIT LEVELS, H. T. Tallack, 246, High Holborn, W.C. 1.

In this spirit level the influence of changes of temperature on the size of the bubble is neutralised by the introduction of a

N°244,360

certain proportion of mercury into the tube. Incidentally the mercury lying in the bottom of the tube forms a good reflector which shows up the bubble plainly.—*December 17th*, 1925.

FURNACES.

244,280. January 3rd, 1925.—MUFFLE FURNACES, J. H. Lloyd, Edgbaston-grove, Birmingham; C. M. Walter, Lyvden, Lichfield-road, Four Oaks, Birmingham; and J. Palser, 14, The Sycamores, Stanhope-street, Highgate, Birmingham.

The inventors claim that, by the use of this muffle and bath, articles can be heat-treated so that perfect uniformity of treatment is secured. The muffle itself, it will be seen, is normal and

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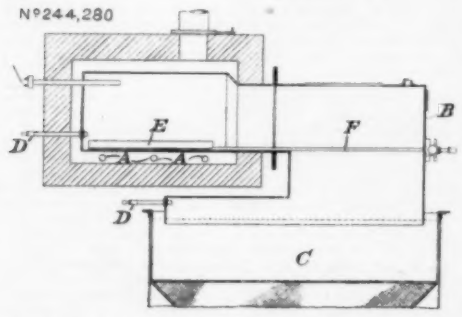

is heated by the burners A A. The chamber is extended through the brickwork by means of a sheet metal casing B, which dips down below the surface of the quenching bath C. Inert or carburising gas is introduced at D D. The articles to be treated are arranged on a tray E fixed on the end of a rod F. When they are heated sufficiently the tray is withdrawn and the articles are tipped into the bath. It is said that in this way each piece is quenched individually.—*December 17th*, 1925.

MISCELLANEOUS.

223,561. October 13th, 1924.—IMPROVEMENTS IN ELECTROLYTIC RECTIFIERS, *Adalbert Béla Muntyan, of* 291, *Heerengracht, Amsterdam, Holland.*

The rectifier of the kind described in this specification may be connected to an alternating-current network having a tension of,

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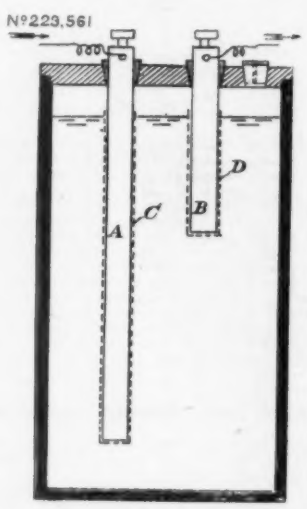

say, 200 volts either direct or through the intermediary of a transformer. The electrolytic rectifier comprises two or more electrodes possessing unipolar conduction, such as aluminium, tantalum, niobium, &c. Before the electrodes are introduced into the electrolyte they are each coated with a film or layer of a metallic oxide. The metallic oxide films or layers on different electrodes are of different natures and of different thicknesses, as a consequence of which the electrical capacities of the electrodes are different. In the example shown in the drawing the anode A must possess a larger electrical capacity than the cathode B. After the electrodes have been coated they are immersed in an electrolyte, such as, for example, H_3AsO_4. The formed metal oxide layer C of the anode A prevents contamination of the electrolyte. As the anode A and the cathode B are made of the same kind of metal, preferably aluminium, there is no possibility of the cathode becoming decayed or corroded. The formed anode must possess a considerably larger capacity than the formed cathode in order to produce a sufficient continuous current from the anode to the cathode. The cathode made of a metal of unipolar conduction is coated with a metal oxide layer which stops the current. The metallic oxide layer is reduced in the electrolyte by the hydrogen which is formed in the electrolyte. The reduction takes place until the dielectric D constituted by the layer is so thin that a large continuous electric current is passed.—*December 11th*, 1925.

Forthcoming Engagements.

Secretaries of Institutions, Societies, &c., desirous of having notices of meetings inserted in this column, are requested to note that, in order to make sure of its insertion, the necessary information should reach this office on, or before, the morning of the Wednesday of the week preceding the meetings. In all cases the TIME and PLACE at which the meeting is to be held should be clearly stated.

TO-DAY.

CHEMICAL ENGINEERING GROUP—Muspratt Lecture Theatre, The University, Liverpool. Joint meeting with the Liverpool Section of the Society of Chemical Industry. Paper, "The Use of High Pressures in Chemical Industry," by Dr. E. B. Maxted. 6 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Chamber of Commerce, New-street, Birmingham. Paper, "Military Engineering Field Works," by Captain H. W. Coultas. 6 p.m.

INSTITUTION OF CIVIL ENGINEERS: YORKSHIRE ASSOCIATION.—Grand Hotel, Sheffield. Annual dinner.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Piston Temperatures and Heat Flow in High-speed Petrol Engines," by Professor A. H. Gibson. 6 p.m.

INSTITUTION OF PRODUCTION ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Paper, "Features of Machine Tools which Make for Increased Production," by Mr. G. W. Rawlings. 7.30 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Lecturette, "The Engineer and his Relationship to the Tea Industry," by Mr. E. Granville-Smith. 7.30 p.m.

NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.—Literary and Philosophical Society's Lecture Theatre, Newcastle-upon-Tyne. Paper, "Cast Iron for Diesel Engines," by Mr. A. Campion. 7.30 p.m.

PHYSICAL SOCIETY OF LONDON.—Imperial College of Science, Imperial Institute-road, South Kensington, London, S.W. 7. Papers: "A Critical Discussion of the Determinations of the Mechanical Equivalent of Heat," by Professor T. H. Laby; "The Present Status of Theory and Experiment relating to Specific Heats and the Chemical Constant," by Mr. F. Ian G. Rawlins. 5 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse, "The Work of the Davy Faraday Research Laboratory," by Sir William Bragg. 9 p.m.

WEST OF SCOTLAND IRON AND STEEL INSTITUTE.—Room 24, Royal Technical College, George-street, Glasgow. Kinema film, "Shipbuilding at Vickers Ltd." Paper, "Open-hearth Reactions," by Dr. A. McCance. 7 p.m.

SATURDAY, JANUARY 23RD.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. Juniors' social and dance. 7 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—City Engineer's Office, City Hall, Cardiff. South Wales District meeting. 3 p.m.

INSTITUTION OF MUNICIPAL AND COUNTY ENGINEERS.—Town Hall, Newcastle-upon-Tyne. North-Eastern District business meeting. 3.30 p.m.

MONDAY, JANUARY 25TH.

BRADFORD ENGINEERING SOCIETY.—The Technical College, Great Horton-road, Bradford. "The Steam Accumulator for Use in Power Plants," by Professor G. F. Charnock. 7.30 p.m.

RAILWAY CLUB.—65, Belgrave-road, London, S.W. 1. Paper, "Locomotive Design and Performance," by Mr. C. J. Allen. 7.30 p.m.

WOMEN'S ENGINEERING SOCIETY.—Visit to the Research Laboratories of the General Electric Company at Wembley. 2.30 p.m.

TUESDAY, JANUARY 26TH.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. Paper, "The Flettner Rudder," by Mr. F. A. Best. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Society of Motor Manufacturers and Traders, 83, Pall Mall, London, S.W. 1. Informal meeting. Discussion on "Tire Pumps and Jacks." 7 p.m.

INSTITUTION OF CIVIL ENGINEERS.—Great George-street, London, S.W. 1. Paper, "Rugby Radio Station," by Messrs. A. S. Angwin and T. Walmsley. 6 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS: NORTH MIDLAND CENTRE.—Hotel Metropole, King-street, Leeds. Paper, "The Use of Induction Regulators in Feeder Circuits," by Mr. L. H. A. Carr. 7 p.m.

INSTITUTION OF ENGINEERS AND SHIPBUILDERS IN SCOTLAND.—39, Elmbank-crescent, Glasgow. Paper, "The Werkspoor Diesel Engine," by Mr. G. J. Lugt. 7.30 p.m.

WEDNESDAY, JANUARY 27TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Temperance Hall, Temple-street, Birmingham. Conjoint meeting with Birmingham Metallurgical Society. Paper, "Metallurgy of Nickel with Special Reference to Work in Canada," by Mr. W. R. Barclay. 7 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS—Brmingham Graduates' visit to the works of Harper, Sons and Bean, Tipton. 2.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS: NORTH OF ENGLAND CENTRE.—Milton Hall, 244, Deansgate, Manchester. Paper, "Logic Applied to Failures," by Mr. J. D. Parkes. 7.15 p.m.

NEWCOMEN SOCIETY.—Prince Henry's Room, 17, Fleet-street, London, E.C. 4. Paper, "John George Bodmer, his Life and Work, Particularly in the Evolution of Mechanical Stoking," by Mr. David Brownlie. 5.30 p.m.

THURSDAY, JANUARY 28TH.

INSTITUTE OF METALS: BIRMINGHAM LOCAL SECTION.—Queen's Hotel, Birmingham. Annual dinner. 7.30 p.m.

INSTITUTION OF LOCOMOTIVE ENGINEERS.—The Engineers Club, Coventry-street, London, W. 1. Paper, "Steam Heating of Trains," by Mr. H. Holcroft. 7 p.m.

FRIDAY, JANUARY 29TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Mechanical Excavators and Concrete Mixing Machinery," introduced by Mr. F. H. Livens. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH.—Grand Hotel, Sheffield. Paper, "Modern Developments in Open-hearth and other Steel Works Furnaces," by Mr. A. Vincent Kemp. 7.30 p.m.

INSTITUTION OF WELDING ENGINEERS.—Philosophical Hall, Park-row, Leeds. Paper, "The Arc Welding of Seams in Steel Plates," by Mr. J. T. Carr. 7 p.m.

JUNIOR INSTITUTION OF ENGINEERS.—39, Victoria-street, London, S.W. 1. Paper, "Comfort in Railway Travel from the Point of View of the Engineer," by Mr. A. N. Moon. 7.30 p.m.

MANCHESTER ASSOCIATION OF ENGINEERS.—The Engineers' Club, Manchester. Paper, "The Value of Research in the Production of Castings," by Mr. J. G. Pearce. 7.15 p.m.

ROYAL INSTITUTION OF GREAT BRITAIN.—21, Albemarle-street, London, W. 1. Discourse "On Films," by Sir W. B. Hardy. 9 p.m.

SATURDAY, JANUARY 30TH.

INSTITUTE OF METALS: NORTH-EAST COAST LOCAL SECTION.—Neville Hall, Newcastle-upon-Tyne. Joint meeting with the Institution of British Foundrymen. 6.15 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—London Graduates' visit to the works of Thomas Tilling, Ltd., Bull-yard, High-street, Peckham. 2.30 p.m.

TUESDAY, FEBRUARY 2ND.

INSTITUTE OF MARINE ENGINEERS.—85-88, The Minories, Tower Hill, London, E. 1. Paper, "High-efficiency Steam Installations for Ship Propulsion," by Mr. Stanley S. Cook. 6.30 p.m.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Broadgate Café, Coventry. Coventry Graduates' meeting. Paper, "Developments in Motor Cycle Design," by Mr. J. R. Harnott. 7.15 p.m.

MANCHESTER GEOLOGICAL AND MINING SOCIETY.—Natural History Theatre, Beyer-building, The University, Manchester. Address, "Mining in Canada, with Regard to Migration," by Sir Stopford Brunton. 6 p.m.

WEDNESDAY, FEBRUARY 3RD.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Midland Hotel, Derby. Derby Graduates' annual dinner. 7.15 p.m.

INSTITUTION OF ELECTRICAL ENGINEERS.—Savoy-place, Victoria Embankment, London, W.C. 2. Wireless Section meeting. "The Propagation of Electric Waves," by Mr. J. Hollingworth. 6 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—The Engineers' Club, Coventry-street, London, W. 1. Annual dinner. 7.30 p.m.

THURSDAY, FEBRUARY 4TH.

INSTITUTION OF AUTOMOBILE ENGINEERS.—Royal Society of Arts, John-street, Adelphi, London, W.C. 2. Joint meeting with Royal Aeronautical Society. Paper, "American Aeronautical Engine Practice," by Mr. C. L. Lawrence. 7 p.m.

INSTITUTION OF CIVIL ENGINEERS: BIRMINGHAM AND DISTRICT ASSOCIATION.—Queen's Hotel, Birmingham. Annua dinner. 6.30 for 7 p.m.

LIVERPOOL ENGINEERING SOCIETY.—Midland Adelphi Hotel, Liverpool. Annual dinner. 7 p.m.

MONDAY, FEBRUARY 8TH.

INSTITUTION OF AUTOMOBILE ENGINEERS: BIRMINGHAM CENTRE.—Chamber of Commerce, New-street, Birmingham. Paper, "Modern Chassis Frame Design and Body Mounting," by Mr. T. D. Carpenter. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: GRADUATES' SECTION.—Storey's-gate, Westminster, London, S.W. 1. Paper, "Submerged Combustion and Submerged Flame Burners," by Mr. E. C. Peters. 7 p.m.

FRIDAY, FEBRUARY 12TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Informal meeting. Discussion on "Refrigerating Machinery," introduced by Mr. G. C. Hodson. 7 p.m.

INSTITUTION OF MECHANICAL ENGINEERS: YORKSHIRE BRANCH.—Hotel Metropole, Leeds. Paper, "The Choice of Steels for Engineering Work," by Mr. A. P. Hague. 7.30 p.m.

FRIDAY, FEBRUARY 19TH.

INSTITUTION OF MECHANICAL ENGINEERS.—Storey's-gate, Westminster, London, S.W. 1. Annual general meeting. Paper, "The Measurement of Cutting Temperatures," by Mr. E. G. Herbert. 6 p.m.

PERSONAL AND BUSINESS ANNOUNCEMENTS

WE are asked to state that, in succession to Mr. F. R. Lucas, who recently retired, Sir Geoffrey Clarke has been appointed to the board of the Telegraph Construction and Maintenance Company, Ltd., and will act as joint managing director.

WE are informed that the Windsor Brick and Tile Company, of Water Oakley Brick Farm, Windsor, Berkshire, has been incorporated by Cement Bricks, Ltd. It is requested that in future all communications should be addressed to the latter firm at the address given.

WE are asked by Mr. J. B. Rudkin, of Albion House, 59, New Oxford-street, London, W.C. 1, who represents in this country Messrs. Sprecher and Schuh, of Aarau, Switzerland, to state that arrangements have been made with Isenthal and Co., Ltd., of Denzil Works, Willesden, London, N.W. 10, to manufacture at those works the products of the Swiss firm to the latter's designs.

WE are asked to state that the firm now to be known as K. L. Kalis Sons and Co., Ltd., of 53, New Broad-street, London, E.C. 2, has adopted that title in place of the former name of E. J. Bakker and Co., dredging and reclamation contractors, of the same address. The company has been reorganised and strengthened by the co-operation of the four sons of the late Mr. K. L. Kalis, of Sliedrecht, Holland.